MACHINERY.

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IMPROVEMENT IN THE FOUNDRY.

W. J. KEEP.

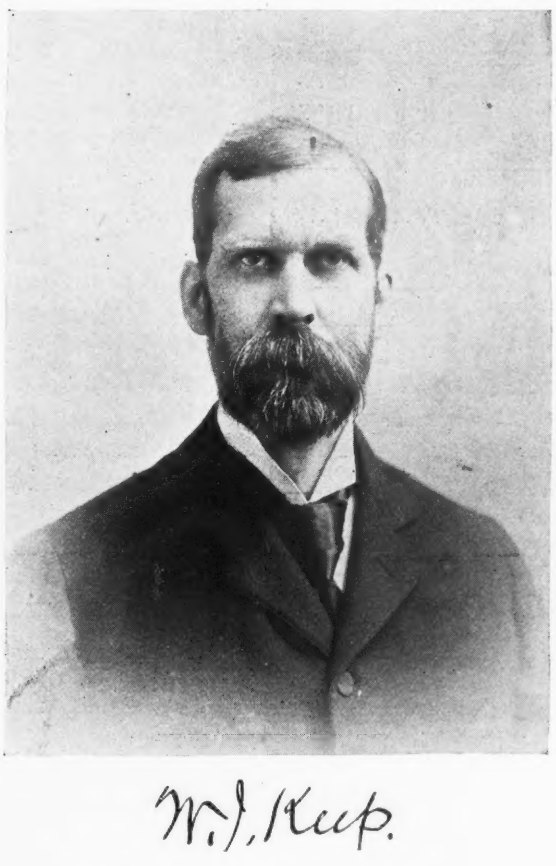
THE most careful thought is bestowed upon the machine department. New tools replace those which are out of date because they will turn out so much more work, at much less cost, that it pays to throw the old machine into the scrap pile.

The superintendent is generally a thorough mechanical engineer and he will systematize his work, so as to get the most out of each workman and each tool. He will lessen waste and will keep records of costs so that he can at any time tell what it will cost to duplicate any part of any machine.

But when we enter the foundry the whole scene changes. The engineering schools have no course of foundry practice. The student makes a few moulds to obtain an idea of the way a pattern leaves the sand that he may make a better drawing for the pattern maker, but no effort is made to train men for foundry foremen.

The foreman in charge of the foundry is usually a good moulder who has worked as a journeyman until he is familiar with making the moulds for work required in that shop. Some are systematic and use their men and materials to the best advantage.

The special feature to which I wish to call attention is the loss occasioned by bad castings. Such losses are often ascribed to dull or dirty iron or to the materials put into the cupola. Great loss is occasioned by hard castings or by hard spots, for when such castings reach the machine shop the tools must be driven slower and much time spent at the grindstone. It often happens that after much time has been put on a casting, a spongy spot is reached which renders it unfit for use.



These things are often considered the unavoidable losses in foundry work, to be regretted and caused by something so mysterious that its useless to seek a remedy.

The mixing and melting of iron is usually in the hands of a so-called professional melter, who is often the only person in the foundry who knows how to prepare the cupola or how to charge the materials. It is sometimes questionable whether the proportions of iron and fuel used are reported correctly, and often it will be found that they are not weighed at all.

The melter is often obliged to use irons which are purchased by some one who knows very little about their nature, and perhaps he does not know what is needed if his advice is asked.

It will often be found that the buyer of the iron, the melter, the foundry foreman, the superintendent and the proprietor know very little about the properties of cast iron, but they imagine that sulphur or phosphorus in the iron or coke is responsible for much of the trouble encountered, and that there is something very mysterious about it all and that the subject is beyond their comprehension. They may have had analyses made, and may have sent back some brands of iron that they were sure had caused trouble, but they seem no wiser for the experience.

The subject is, however, so simple that any one can master it in a very short time if they will abandon all erroneous opinions.

The rules that regulate a foundry mixture are not complicated, but it seems almost impossible to fix them in a founder's mind.

The following are the most important:

The measure of the shrinkage of a given size of test bar will indicate the quality of the iron that enters the mould.

If the shrinkage is great, the grain will be close and the casting will be hard. If the shrinkage is small the grain will be coarse and the casting will be soft. Iron that shows a large shrinkage in the test bar will make a weak small casting and a strong heavy casting, and vice versa. Poured from the same iron, a small casting will shrink more than a large casting and the grain of the large casting will be coarsest, and it will be softer but not as strong per square inch as the closer grained small casting.

Therefore iron suitable for large castings should show a greater shrinkage in the test bar than if it is to be used in small castings.

As soon as it has been found what shrinkage in the test bar accompanies the most satisfactory castings, it is certain that so long as this shrinkage is maintained the quality of the castings will be uniform.

Adding No. 1 pig iron or Nos. 1 or 2 Soft Southern iron, or a smaller quantity of anyone of the silvery softeners, will reduce the shrinkage and will make hard castings soft; but an excess will cause spongy spots and shrink holes in large castings.

Hot iron will be clean iron and will make castings free from blow holes.

Strength is a property wholly dependent upon the size of the grains and the manner in which they interlock, therefore a different proportion of irons without varying the shrinkage of the test bar, will increase strength. Close grained pig iron or scrap will produce closer grained castings than pig iron with an open grain.

Pig iron made from one furnace on different days will not have the same quality, and for this reason it is better to use a small quantity of several pig irons in each cupola charge. When this is done, any chance variation in any one brand of iron will not affect the casting enough to be noticeable.

An exact daily record must be kept of all brands of iron put into the cupola and of the shrinkage of a test bar.

The shrinkage of a test bar will give you more practical information than can be obtained from any chemical analysis.

In applying these rules when anything seems mysterious, a

question should be sent to some one who can give an explanation. In this way in a very short time all mystery and superstition will vanish.

In cast iron, as in all other things, there are exceptions to all rules, but as a general thing they will not often be encountered.

If the same care is bestowed upon the melting and mixing of iron and upon the shrinkage test, as upon the details of the machine shop, the profits of the company will be greatly increased. In a short time it will be found that as perfect and as strong castings can be made from the cheapest pig irons as with some of the high priced brands which are looked upon as necessary.

I doubt if the average foundry melter or foreman has acquired the habit of accuracy and of reasoning from cause to effect, and it would, therefore, be better for the superintendent to take the iron mixing into his own hands. After he has become familiar with the control and regulation of his foundry mixture by the shrinkage measure, it may be a satisfaction for him to gain a correct idea of the action of silicon and carbon and of the other elements in cast iron.

* * *

A SYSTEM OF DRAWING ROOM RECORDS.

HENRY HESS.

The plan to be described has been gradually developed from the writer's experience of the good and bad points of many now in use, and is the outgrowth of a process of trial covering an extended period.

Probably as good a way as any to present it is to give the governing rules with explanatory remarks.

SYMBOLS.

1. Every machine detail is given a number. This number is never used for any other piece. The symbol number will therefore completely identify a piece, without regard to how many otherwise different machines that piece may be used for.

Let No. 3 be a certain case.

2. When a detail is so changed that it can no longer be used in place of the original piece it is given a new number.

3. Each machine as a whole is assigned a capital letter or combination of capital letters as a symbol.

It is best to make these symbols entirely arbitrary, as any attempt to use initial letters is sure to sooner or later break down, either from the tendency to use different names for all but a very few classes of machines, involving confusion of initials, or from the occurrence of the same initials in names of different machines.

Let A mean a lathe.

4. With such machines as are conveniently classified by certain definite dimensions these are to be prefixed to the letter symbols. Thus 24 inch A means a 24 inch swing lathe.

5. The main symbol of each machine is to be followed by a small letter to indicate changes in design. Thus 24 inch A *a* stands for a 24 inch swing lathe of the first or "*a*" design, 24 inch A *b* for the second or "*b*" design, etc.

24 inch A *a z* shows that cone *z* is used with a 24 inch swing lathe of design "*a*," while 13 Z*y z* shows that the same cone *z* is also used with a 13 inch slotter of design "*y*."

DRAWINGS.

6. Each detail is represented by a drawing on a sheet bearing the same number as the detail, and but one piece is shown on a sheet; this number is plainly inserted at the lower left-hand and upper right-hand corner of both the face and reverse side of the sheet. For convenience of conversational and shop reference, the symbols of the various machines with which a piece is used are also given in the sheet.

Having but one piece in a sheet does away at once with the need for any form of index to find the sheet symbol, as that being identical with the piece number is known as soon as the lathe is known.

7. Each design or assembly drawing is treated as a piece and given a piece number.

8. When a drawing is to be slightly changed, and *provided this change is likely to be permanent*, work may be saved by taking a print of the unchanged drawing, filing this as an original, and then changing the drawing, care being taken that the symbols also are duly altered. When the change is a temporary one only, corrections are made in the print and this is then filed as would be a new sheet.

9. All sheets are of standard dimensions. The original is $39\frac{1}{2}$ x 26 inches, and this is subdivided by binary divisions; each sheet size is then known by its pattern as $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{16}$, $\frac{1}{32}$ and $\frac{1}{64}$, making seven sizes in all.

10. For purposes of ready and convenient filing, the $\frac{1}{4}$ size is considered the standard sheet. Larger ones are to be folded down to this, while smaller sheets are not cut apart on the original.

11. All drawings are filed away in flat trays; each tray is to hold twenty-five sheets, and is plainly marked with the first and last number of the drawings it is to contain. In the trays themselves the sheets need not be filed in numerical order.

DETAIL LIST BOOK.

PIECE Nº	PIECE NAME	USED WITH MACHINES & DESIGNS:						
1	Headstock	24 Aa	24 Ab	24 Ac	Perm'ly changed to Nº 109*			
2	Spindle	24 Aa	24 Ab	24 Ac	24 Ad			
3	Cone, 3 step, 4", 12 to 18"	24 Aa	13 Za	24 Ad				
4	Facegear, 18", 3 f	24 Aa	24 Ad					
5	Conepinion, 6", 3 f	24 Aa	24 Ad					
6	Backgear, 18", 3 f	24 Aa	24 Ad					
107	Cone, 4 step, 3", 12 to 20"	24 Ab	24 Ac					
108	Facegear, 20", 3 f.	24 Ab	24 Ac					
109	Headstock	24 Ad						

* This note entered in red ink.

FIGURE 1.

The number of sheets, twenty-five, assigned to each tray has been adopted as a compromise between the work involved by the need of filing in order in each tray if it contains many sheets, or the work of, on the other hand, handling a large number of sheets when they are not regularly filed.

RECORDS.

12. A Detail List Book is provided, containing in numerical order a list of all pieces, giving their number, name and the symbols of the various machines they are used with. In choosing the name, care should be taken to make this as fully descriptive as possible, yet concise; information regarding the location of a piece is not to be given, since that may vary with machines of different character; thus, "*z*, cone, 3 step, 4 inch, 12 to 18 inch," is correct, whereas "*z* 7 driving cone" would be bad.

A new piece in drawing to be assigned the last free number shown by this book.

The columns showing the various machines a piece is used with become very useful in determining with little labor which

are live patterns when an overcrowded pattern storehouse confronts the superintendent with the disagreeable alternative of enlarging or of making room at the risk of destroying patterns likely to be called for again. This also comes in when it is decided to make the more frequently used patterns more accessible by crowding together in a lump space those not so frequently used, yet too valuable to be destroyed. Then, too, when it is a question of the relative economy of changing a pattern or making a new one, taking into account the likelihood of having to restore the changed pattern, this book becomes of value in presenting at once the data on which to base a judgment.

Fig. 1 gives a sample of this book.

13. A Machine List Book is provided for each type of machine, containing in numerical order a list of the various pieces entering into the composition of the machine, the names of such pieces, the number of each required, and the material. Also a series of columns headed by the small design symbols of rule 5. Under each design letter the symbol number is to be repeated if in almost any shop), the duplication is either hastily made with probable errors, or not at all, or a cross reference on a piece of paper is stuck in to be lost sooner or later, and at the best bringing about that hunting in another place for a drawing that was objected to. If on the other hand the drawings are not grouped for each machine, the need of routing them out of their various places by the aid of a finding list each time an even cursory inspection is to be made of the relation of parts of a certain machine, leads undoubtedly to good deal of loss of time, or of taking things for granted that should be verified.

With this plan of bound sets of reference prints, the advantages of both methods are retained with the disadvantages of neither, while it has also certain other points peculiarly in its favor. What office, for instance, has not experienced the annoyance of having a set of drawings called for by the manager's office, and on return found one or two missing, to be met with the positive assertion that all were returned, only to find, a month or six months later, that they had been safely stored away in the

MACHINE LIST BOOK. FOR Lathe 24" A.

PIECE NO.	PIECE NAME	GROUP	MATER'L	NO. WANT'D	USED WITH DESIGNS: a	b	c	d	e	f	g
1	Headstock	Head	C. I.	1	1	1	1	*See 109			
2	Spindle	"	Crucible St.	1	2	2	2	2			
3	Driving cone	"	C. I.	1	3	*See 107	—	3			
4	Facegear	"	St. Cg.	1	4	*See 108	—	4			
5	Conepinion	"	Mch. St.	1	5	*See 120	—	5			
6	Backgear	"	St. Cg.	1	6	*See 121	—	6			
7	" pinion	"	Mch. St.	1	7	*See 122	—	7			
8	" quill	"	C. I.	1	8	8	8	8			
9	" spindle	"	Mch. St.	1	9	9	9	9			
107	Driving cone	Head	C. I.	1		107	107	*See 3			
108	Facegear	"	St. Cg.	1		108	108	*See 4			
109	Headstock	"	C. I.	1				109			

* Items entered with red ink.

FIGURE 2.

Inspection of the last calumns show that No. 3 f. i., was used with design "a," was then dropped for 107 for designs "b and c," and was again used with design "a."

these pieces are used with that design. When a piece is replaced by another there is entered in line with it, with red ink, in the proper design column, the symbol number of the new piece. It is well to enter a dash for those pieces not used, as this shows plainly the intention to drop them, and does not leave room for a suspicion of an oversight.

This book forms a most complete and yet very compact chronological history of the evolution of a machine, telling just when and what changes were made, and if coupled with a counting-room record of the design symbol of machine furnished with certain orders gives complete knowledge in detail of what was furnished for any order.

See Fig. 2 for a sample of this book.

14. A Symbol Book is provided in which are entered in alphabetical order the letter symbols of rule 3, together with the names of the machines. This is to be consulted when choosing new symbols.

15. A Card Index containing in alphabetical order all probable or possible names under which a machine might be thought of is to be used for finding the letter symbol of the various machines.

For a small business, or one not dealing with any great variety of work, this may be dispensed with.

16. A complete set of blue prints on thin paper is to be taken of each machine design, bound together and filed away in the sequence of the machine letter symbols.

This is for convenience in referring to any design, and to avoid the very objectionable delay otherwise attendant upon gathering together all the various detail sheets. It is this matter of the ready collection of the details that is the general stumbling block in the methods in use. If they are grouped together for each machine there comes in the disadvantage of the duplication of drawings when the same piece is used for different machines, and when time presses (and it will do that in a drawing office manager's fire-proof vault? By sending down the bound set of prints, even if this should be lost completely, a new one could be prepared at the cost of only a little time and blue-print paper.

* * *

BELTS AND PULLEYS.

F. F. HEMENWAY.

Prof. Sweet's remarks on the subject indicated by the heading, brings up the distinction between the high side of a pulley and the point of greatest diameter, in the clear way it ought to be brought up. When a pulley is measured with a view to determining how a belt will run on it, it is necessary to measure that pulley just by itself and not in its relation to some other pulley on some other shaft. That is another branch of the subject, very important sometimes, but not relevant to the question at issue.

The Professor's remarks makes a little story that shows that the confusion as between the diameter of a pulley and the high or "off" side rather pertinent. The story has the merit of being true, anyhow.

A shaft was in use in the works for about three hours a day. The belt was over-taxed. Some time after being put to service the belt showed a tendency to run off at one side of the pulley. The foremen appealed to a workman to remedy this tendency, during the noon hour. In a way rather common to mechanics, both foreman and workman "squinted" across the shafts and determined neither end of the counter required to be raised. One hanger must be moved. The end to be moved was decided upon, but the foreman was hardly satisfied.

"Which way are you going to move that end?" said he.

"Oh, just as I always do. I look carefully at the running of the belt and conclude just how far in a certain direction I ought to move the hanger to make it run right, then I move it just that

distance in the other direction, and the belt generally goes about right."

Jim was just as much confused as any of us between the diameter and the "off" side of the pulley, but he turned his confusion to good account.

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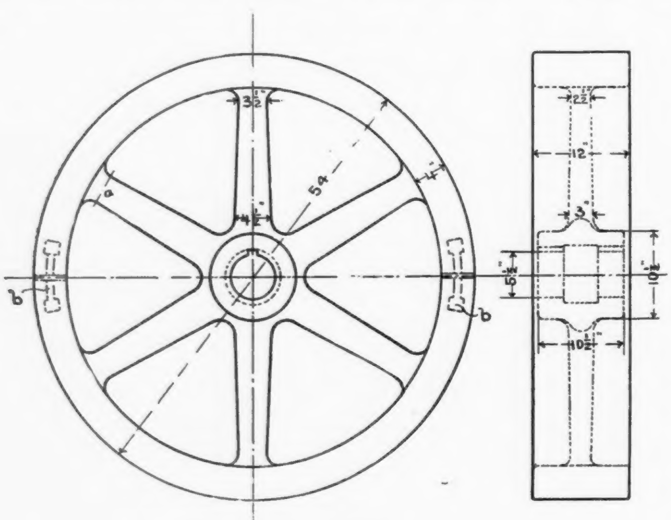
A FLY-WHEEL CASE.

Wm. Sangster.

Once in a while we make things and then wish we could do it all over. This is often true of pulley arms. They look large enough in the drawing, but afterward they seem to shrink and grow smaller.

The following description and accompanying sketch of a fly wheel may prove interesting as a bit of experience. The wheel made but 100 revolutions per minute, so no attention was paid to centrifugal strains. The rim was swept up and the arms made in cores after the usual fashion. The casting was poured Saturday night and left untouched until Monday morning. It was then uncovered and found uncomfortably warm to the hand, but appeared a sound and satisfactory casting. Two or three hours afterward a crack was observed in one of the arms, at A. It was thought wise to attempt burning it together, although doubts were expressed as to its feasibility. The wheel was placed under the drill press and a series of 1½ inch holes drilled across the arm, at the crack. The noon whistle blew before this was completed, and it was left unfinished. On the workman's return he found that the wheel had contracted, leaving about ⅜ inch instead of ½ inch space across the holes lengthwise of the arms. The burning did not prove a success, and it was decided to make another casting.

To avoid again breaking the arms, which, to the vexation of the draftsman, was laid to his making the arms too small, ½-inch cores were set in the rim, as shown at b b, and also cores for the I-slots at each side. It was intended to shrink forgings into these spaces, and afterward run in babbitt to make smooth surfaces. However, by a mistake in the cores, about 1¾ inches



A FLY-WHEEL CASE.

square of metal was left in each corner of the rim, and there was not time to correct it.

After pouring and allowing it to cool a little, the sand was removed entirely from the rim of this wheel, and as much as possible of the hub left bare. Monday morning it was cold and showed no signs of a crack anywhere in the rim or arms (this to the joy of the draftsman). The spaces in the rim were filled with babbitt and the pulley finished. It has run now for three years and given entire satisfaction. Since this experience, all the heavy wheels at that place have been cooled by baring the rims and hubs, keeping the arms covered.

* * *

NOTES FROM A ROVING CONTRIBUTOR.—4.

A CALCULATING MACHINE—A PHILOSOPHY OF MANUFACTURES—FRENCH DRILLING MACHINES—CASTING SPUR WHEELS—WATERBURY WATCHES—WALTHAM AND GENEVA—A CARPENTER'S OUTFIT—DITTO FOR A MACHINE FITTER—MECHANICS AND ETHICS—CRANES VS. CROW-BARS.

The Editor has overtaken me with a very sensible letter, asking for "economic" points, says he—"shop tools and processes are to earn money, not a device for health or amusement." Then he adds: "We make things for the difference between what they cost and what they sell for."

This last knocks all the romance out of technology. Imagine a professor standing up before his classes and making a statement like that: He would not do it. He would say, "You young gentlemen have chosen a calling exalted above others. To control and direct the powers of nature is your mission. To your will must bend the mysterious forces of physics, the hidden elements of material, the phenomona of chemical reactions, and the occult causes that underlie all natural sequences."

This is not economics however, and will not be accepted as such. The term is confusing, even a dictionary fails to supply a meaning of the word. We turn to facts.

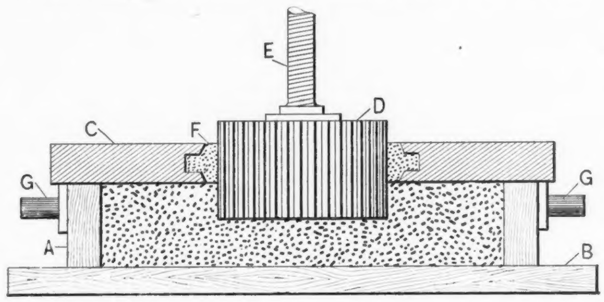
Away back in 1832 Charles Babbage, professor of mathematics at Cambridge University, wrote a book called "The Economy of Manufacturers." Not one in a thousand readers of this paper has ever seen the book of which 3,000 were printed at a cost of about $1,300. It would now cost about $130 and not be worth much more; but it is a book full of thought and suggestion.

Professor Babbage made the great calculating machine or "difference engine" that cost the British government enough to build a gun boat, and is now to be seen in the Kensington Museum in London. A "kist o' wheels," a Scotchman would call it, worth, for practical purposes, about two cents a pound; but it gave the professor an idea of constructive processes, also the idea of his book which is an attempt to "generalize processes" and successfully too, up to a point, then possible.

Then Dr. Andrew Ure, M. D., F. R. S., M. G. S., etc., etc., not to be outdone by another professor, wrote the "Philosophy of Manufacturers;" which, like the Doctor's name is mainly "title." "A compilation of facts respecting the textile industry in Great Britain" should have been the title. The book is of no use, and is mentioned here out of courtesy to my predecessors. The great central fact in the economy of industry is centralization. Like all honest human avocations, the making of things belongs in the "struggle for existence." Competition measures success. They make fine ware at Sevres; brass buttons at Ansonia; pocket knives at Sheffield; pins at Waterbury; watches at Waltham, because of the concentrated skill. Local resources do not amount to much. It is accident, training and energy. About twenty years ago there appeared first in the European market and a little later in this country, a very complete form of hand drilling machines, back geared, well geared, a fly wheel on top of the spindle; in other words a well designed machine. These machines can now be found in blacksmith and other shops all over the world, the best and most of them coming from France. When they began to come into England the "Brummagen" trade laughed and tackled the job at once, but got beaten which turned the laugh the other way. Few things made of metal or for which there are resources there, get imported into England. There is no tariff or even sympathy to fall back on. The merchants would just as soon buy in one country as another, and the orders for those drilling machines kept on going to France. The Belgians and Germans had a try, but it did no good, and finally a mechanic in Sweden who thought of trying his hand, went once to France to see where these machines came from. He found out—found a whole village making them; men, women and children. It was their sole business, and by concentration of skill and division of labor, they attained an unassailable trade.

In this country the tariff kept them out and imitations are made, of the red and green varnished type and I am ashamed to admit far from as perfect as the French ones. These are made like Waterbury watches, not as to machine processes perhaps, but otherwise; heriditary skill being the main element.

The wheels are the main thing, Perhaps I had better digress to tell how they are made. The sketch shown will explain the



"method" but not more. A, is a flask; B, a bottom board; C, a metal template, fitting on the flask; D, a pattern for a spur wheel of metal, engine cut; E, a screw to draw the pattern; F, a template of antimony, lead and bismuth, poured around the teeth and finished off flush on each side of the plate, C. The pattern is pushed down through the plate C to produce the face wanted. The plate is laid on the flask and fastened; then, the flask is turned over on the trunnions, G, the sand rammed hard, well vented by a wire and gated over the pattern. The flask is then turned over the pattern drawn by the screw E, a sand cap put on and the job is done.

Now imagine from five to ten patterns in the plate C, alike or different, and the whole will be clear. I do not suppose there is a single new feature in all this but it is the manner in which true wheels can be and are made for the trade and for the French drilling machines.

I want to say a little more of this wheel matter. It should be a distinct business and it is in England and the Walker Mfg. Co., at Cleveland, Ohio, is an example here. The patterns in an English machine works do not include gear wheels. These are procured from a "wheel maker" and happily so, because they are correct and will run true and noiseless. You send the centers, speeds and face to a wheel maker. He does the rest. If there are patterns required, which is not often, that is the wheel makers affair, not his customers. It is a perfect system that all countries will come to sometime.

Wheel making in a common foundry is like making cabinet ware in a cooper shop, and the patterns, three fourths of them, belong in the boiler room. Cutting small bevel wheels is like painting a lily. If cast perfect (not cut) they will run noiselessly. The Philadelphia shops do not cut bevel wheels except of fine pitch or special ones. This and more like it is what I understand the editor to mean by shop economics.

Speaking of Waterbury watches I am told that the first one cost $15,000, and the thousandth one $2.50, perhaps more than it was worth, but be this as it may, the scheme was a triumph of organized manufacture—of machine processes.

Here is a power before which hereditary skill goes down like the army of Senacharib, that "on the morrow lay withered and strewn."

This destruction of hand skill by machines has been a potent cause of social destruction all over the world in the last fifty years. It requires generations to develop human or hand skill, which a ruthless inventor may destroy in a few months.

Geneva at five francs a day could not stand against Waltham at five dollars a day. American machine made watches, of dearer material and taxed with an expense account four times as great, were and are carried across the Atlantic by the bushel, but the Swiss who are a wonderfully shrewd people put in machines. Wages doubled thereby; the women went to housework, the children to school and the watch makers earn more profit.

Verily this world of ours has been turned upside down. Fifty years ago it required a chest 20 inches wide, 18 inches deep and 40 inches long to hold the tools of a common joiner; seven cubic feet of implements. He required a hollow and round planes, panel plow, dados, fillesters, notch planes, augers and other standard moulding planes, jointer, fore, jack and smooth planes, five or more saws, a set of firmer chisels, also mortice chisels with a lot of lingaree that a carpenter nowadays don't even know the name of. Those tools were needed too. Now he wants a claw hammer, two saws, a square and a pocketful of nails. The work is made at the mill and his business is to nail it up to drawings.

The machine fitter is much the same. Forty years ago he required an outfit of implements which at this day has become the sign of a "duffer," (latin for muff). Ten chisels, twelve files, three hammers, straight edges, squares, surface and other gauges, breast drills, center punches, scratch awls, spirit level, chasers and an assortment of small taps, wrenches, and etc., making up a hundred pounds of implements which was a common outfit. Now he comes to the shop with a hammer and a pair of overalls, and is ready for business. The rest, if anything more is wanted, he gets from the tool room; but not much is required, the machines do the work.

The whole system, as before remarked, is a struggle for existence, and implements the issue. Hereditary skill has gone down before implements and organization, the same as in a war, which in fact it is—a war between manual skill and machine processes. What will be its future and consequences can not be written in these notes. Even its past is a mystery, in so far as influences on social life and the convictions of men.

I do not know what the editor included or had in mind when he spoke of "economics." He either did not consult a lexicon or else has a lot of faith in me. There are roads leading in all directions. "Economy" is the most elastic word in our language—an idea not a thing. There is an economy of files, waste and oil; another economy of policy, management and ethics. Then there are economies of wages, labor and finance, also an economy of cranes and crow bars to more machines and material.

A "roving commissioner" may cover all of them, and if so I will not require a new job during the present century.

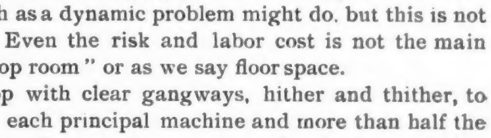
This last named branch of shop "economy" is one of much interest; and most people, the professor included, will set out to compare crowbars, pieces of gaspipe and blocking with an overhead crane, which as a dynamic problem might do, but this is not the main point. Even the risk and labor cost is not the main thing. It is "shop room" or as we say floor space.

Arrange a shop with clear gangways, hither and thither, to the doors and to each principal machine and more than half the shop room is lost. One man to 200 square feet is about all that can find room on a floor thus managed. Put a travelling crane overhead and move things as one does chessmen, over the top of each other, and the same shop will accommodate from double to three times as many men and turn out work in proportion; cheaper too, with a fraction of the danger and risk in handling. To find out what the economics of this means take into account the disorder, encumbrance and risk of the roller and crowbar system, also the charges against product, for rent, heat, light and maintenance. It will amount to a reasonable profit on the week. Still we have been terribly slow in finding out this fact, but now the idea is ahead, and recent shops are well arranged. If I had a machine shop to build, which is a most unlikely circumstance, I would erect a gantry and crane, then add the rest. Next I would buy a face lathe—but there is no use in fancies so remote from probable fact.

* * *

A POCKET WRENCH.

Probably no one in the trade has devised and brought out more different styles of small wrenches than Mr. Chas. E. Billings, the president of the Billings & Spencer Co., Hartford, Conn., whose drop forgings and specialties have won them an enviable reputation. The majority of these small wrenches have resulted from the demands of the bicycle builders, to whom this company supply many thousands each year. The one shown is the '97 model and is made with round corners so as to avoid the frequent trip to the tailors, which carrying the ordinary many cornered pocket wrench necessitates. It weighs but 5½ ounces and opens to 1¾ inches, a large capacity for such a light wrench, yet it is as strong as is required for a wrench this size. Address as above for further information regarding it.



FOUNDRY COST-KEEPING.

H. M. Norris.

Can we afford to take the work at that price? Are we paying running expenses? Is the foreman as good a man as the old one? Is he saving us any money? Why can't we compete with Jones? These are only a few of the questions that present themselves for solution in and about a foundry; but how many superintendents and managers are there who can answer them with any degree of accuracy. Four words, "Look at the books," should be, and is, a sufficient reply to such inquiries in all well regulated foundries; but alas, these are few and far between.

System is just as essential to a foundry as it is to any other branch of manufacture, and should receive the same amount of attention; the results derived from the workings of a good system invariably paying high interest, and are well worth the time and thought spent in getting it up. When the foreman knows that the result of his labor are being watched at the office, and that any saving on his part will be seen and appreciated by his employers, he has a much greater incentive to follow up his men; he will take more pride in his work, strive harder to keep down expenses, and strain every nerve to make each month's report show up better than the last. In fact, system, while perhaps not the life of trade, may be said to be the frame-work upon which trade depends for its support, and it is the key to the success of large undertakings of all kinds.

A jobbing foundry, running on a great variety of work, requires a more elaborate system than one connected with a manufacturing establishment in which they only do one class of work. But the information sought is identical in either case; hence the cost at which this information may be obtained is the measure of value of any system.

In foundries where the work is fairly uniform, a form of daily report, such as shown in Fig. 1, may be used to good advantage. Items marked with an asterisk (*) are filled out by the foreman, or his clerk, each morning for the day preceding, when the report is sent to the office and the cost of the iron, fuel and wages are figured from the books. The general expense, by which is meant all items not otherwise chargeable on the report, is read from a curve, Fig. 2, based upon the ratio known to exist between the general expense account and the total number of pounds melted per day, as previously determined by a more accurate method. At the end of each month these reports are gone over and the results averaged and entered upon the form shown in Fig. 3, which is sufficiently clear to require no further explanation.

DAILY FOUNDRY REPORT, CUPOLA 42.

Fig. 1. September 19. 1896.

Statement of one day's heat.	Grade.	Weight.	@	Dollars	Cents.
Pig Iron, Rome	2	1500*	.755	11	33
" " Hector	2	3500*	.591	20	68
" " Dora	2	7500*	.531	39	82
" " Alice	2	7500*	.518	38	85
Scrap Iron		13000*	.402	52	26
Sprues, &c		5500*	.550	30	25
Total weight of charge		38500			
Coal					
Coke		3612*	.213	7	69
Wood		283*	.055		16
Day worker's time, cost				75	32
Piece work, cost				17	04
General expense, including sand, rent. &c				45	00
Total				338	40
Less for Sprues, Pig Bed and bad Castings		3118*	.550	17	15
Grand Total				321	25

Total weight of perfect Castings.................. 33,979* lbs. Cost per lb...................... .0094

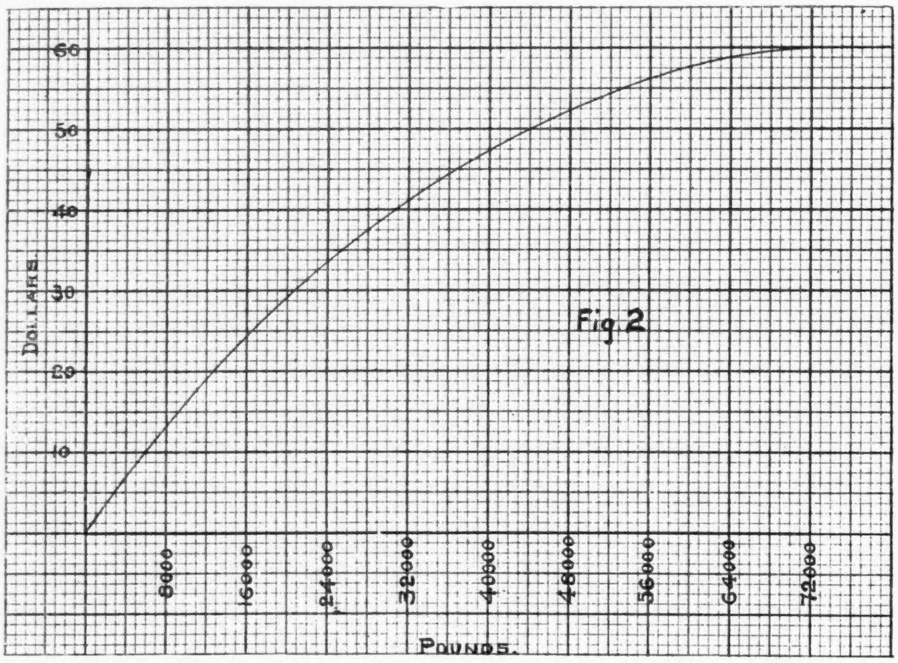
Loss in Melting	1,403 lbs.	Number of Coremakers	3*
Pressure of Blast	.... oz.	Number of Furnacemen	4*
Number of Moulders	21*	Number of Carpenters and Helpers.	1*
Number of Laborers,	14*	Number of Boys	6*

Remarks...

E. O. Smith, Foreman.

Fig. 3. MONTHLY FOUNDRY REPORT.

Classification of Items.	Sept.
Average number of Moulders (men)	25.30
" " " " (boys)	6.60
" " " Coremakers	3.13
" " " Furnacemen	4.
" " " Laborers and Chippers	21.56
" " " Carpenters and Helpers	1.
" Pressure of Blast	....
Total number of Hands	62.60
" " " Heats	23.
" " " lbs. Melted	747300.
" " " lbs. Good Castings	654443.
" " " lbs. loss in Melting	25264.
" " " lbs. Melted per lb. of Coke	10.13
" Cost of running Foundry	$6627.38
Per cent. of Coremakers to Moulders	.098
" " " Laborers and Chippers to Moulders	.675
" " " Good Castings per lbs. melted	.875
" " " Loss to pounds Melted	.033
Number of lbs. Good Castings per Heat per Man	454.
Cost of Good Castings per Pound	$0.0103



PLANING AN ARC.

W. E. Hunter.

The August issue contained an article and sketch of a planer attachment which was used in planing radius-plates for a swing bridge track. The writer wished to know what curve is generated by the device. This curve may be traced by the following method:

Lay off the distance, $3\frac{3}{4}$ inches, from F to the center of the sliding-box (see above article) as F H in Fig. 1. Erect a perpendicular K O at the center of this line. Draw O H so that the angle K O H is equal to 16°. Draw O F. From the center O, describe the circle F H *M*. Place pins at F and H. Make a triangle with smooth edges, having one side greater than F H and subtending an angle of 16°, the other two angles are immeterial. Insert the 16° angle through the opening between the pins, to the left. Keeping its edges against the pins, move the triangle until the distance from its apex to F is $1\frac{5}{16}$ inches, then draw P F A and P H, P being on the circumference of the circle. At the same time, lay off and mark *on the triangle*, on the edge passing through F, a distance of $2\frac{1}{4}$ inches from the apex. This latter point is T, our tracing point. Wherever it moves to, if the edges of the triangle are kept against the pins, or if the same edge points to the same pin, will be a point in the curve. A notch in the edge at T will help retain the pencil. The lettering of Fig. 1 is the same as in the drawing shown in August: F A is the center line of the bed, F H a line connecting pivot F with sliding box, P H is the guide bar continued until it meets F A, angle H P A is 16° as in the drawing, and the tool is located at a point $2\frac{1}{4}$ inches from P. We are now ready to trace the curve. Conceive the pivot F and sliding-box as stationary and the points A, T, P and D as movable, as it is easier to move the triangle than the paper. I think it will be perceived that T must trace the same curve on the paper that it did on the iron, when in the center of the cross-rail, as it is controlled in its movements in the

same way the chuck was when moved under the tool, *i. e.*, P A must always pass through F, and P D through H, while the relation of the guide-bar to the bed is fixed. The curve is shown as F, *n*, R, F, S, V, F.

F, *n*, R is easily traced. When the point of the triangle runs off H, use a straight edge against H and P D until the point runs off F. Two straight edges can be used now, but it will be better to put the triangle between the pins again, and by means of the straight edge take a new tracing point, $2\frac{1}{4}$ inches beyond P along A P.

The dual character of the curve is evident in the planing device and is equivalent to the chuck swinging around at the end

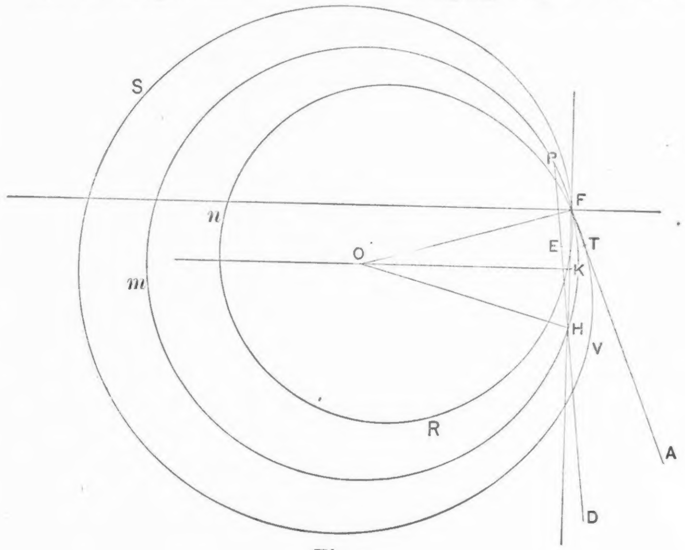


Fig. 1

of a complete stroke and heading back reversed end for end. The inner part of the curve is traced when F is in front of the tool and the outer when back of it. The portion F V represents that portion lying on the chuck.

If now, a hole is put in the triangle for a pencil point, on a line right angled to the edge from T, and at a distance from T equal to half the width of the radius-plate, this point will trace one side of the plate, and a fixture may be attached to the triangle to trace the other side, in the same way. These side curves cross one

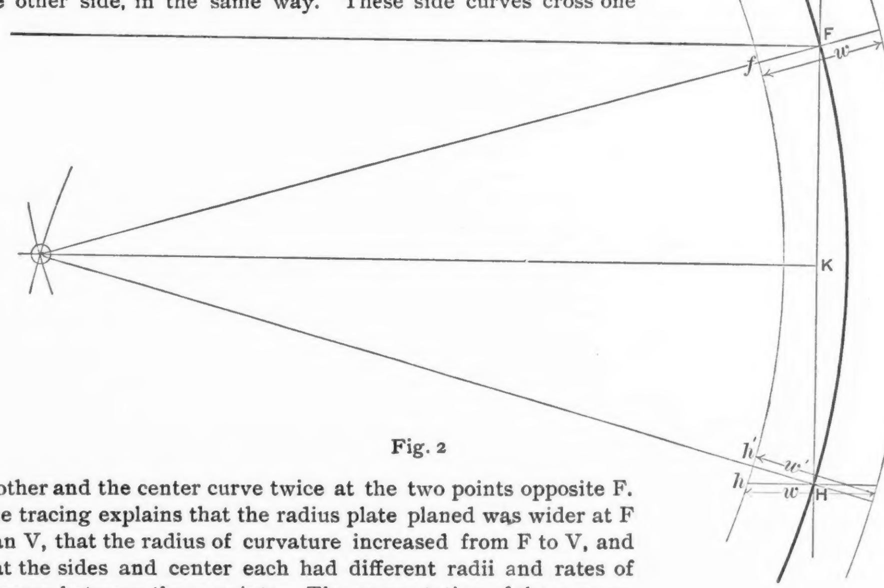


Fig. 2

another and the center curve twice at the two points opposite F. The tracing explains that the radius plate planed was wider at F than V, that the radius of curvature increased from F to V, and that the sides and center each had different radii and rates of increase between those points. The computation of these quantities involves the solution of a fourth degree equation, and is not practical.

To anyone who has gone through the process of tracing the center curve, it will hardly be necessary to say that if T was moved to the apex of the triangle it would trace the circle F M H. This is in accordance with Euclid, Book III., Prop. 21: "The angles in the same segment of a circle are equal to one another." This transfer of T to the apex of the triangle can be accomplished in the planing device by shifting the end of the guide-bar so that it intersects the center line of the bed over the tool point. If the guide-bar was changed in this manner, it would correct the error of the center line, but not the sides. To find the amount of this discrepancy,

Let w = width of piece to be planed,

w' = " " " at sliding box,

Angle D P A = A; consider center line of bed coincident with F H, and the tool at H. See Fig. 2. Draw H h at right angles to F H, and lay off F f on O F, each equal to $\frac{1}{2}w$, then will

Angle h' H h = K O H = A,

Angle H h' h = 90°, nearly.

$$\text{Cos. A} = \frac{\frac{1}{2}w'}{\frac{1}{2}w}$$

$w' = w$ cos. A, approximately.

This narrowing of the plate can be halved by blocking out the end of the cross slide, Fig. 3, one-half the angle D T A, or by using a slide-rest set on the same angle. The same thing can be done by pivoting the chuck in the middle of its length. In this case both ends of the plate will be alike and of less width than the center. Decreasing the angle A will also decrease this variation, but will increase the radius. To make the appliance do true work in all respects will require an addition built out from the chuck to the center of the circle for supporting the end of a rod there running to the tool holder, to keep the slide radial; the tool, when in the center of the bed, being in the center of the rotary motion resulting. As the center of the arc is in motion this addition is hardly practical.

Ignoring this latter suggestion, it looks as if the device might be used to advantage on some classes of work, the radius of curvature is so readily changed through the angle A.

Again referring to Fig. 1, if T is placed at P, the radius of curvature is obtained as follows:

Let P H = b,

Angle H P A = A,

F O = R,

F K = $\frac{1}{2}b$, then,

$$\text{Sin. A} = \frac{\frac{1}{2}b}{\text{R}} = \frac{b}{2\text{ R}}$$

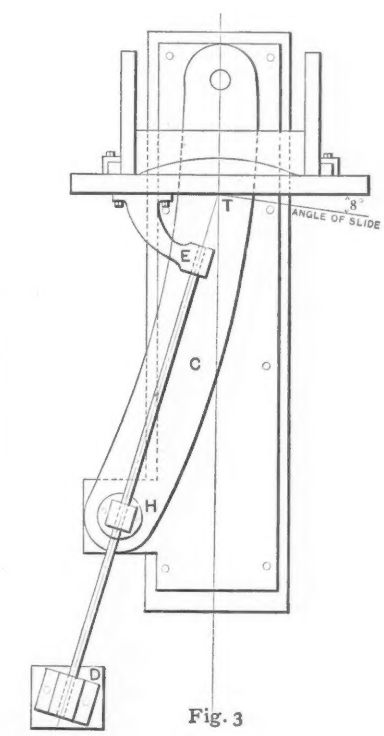


Fig. 3

$$\text{R} = \frac{b}{2 \text{ sin. A}} = \tfrac{1}{2}b \text{ cosec. A.}$$

Taking the value of $7\frac{1}{2}$ feet for b, to find the value of A, when the radius desired is 13.6.

$$\text{Sin. A} = \frac{b}{2\text{ R}} = \frac{7.5}{27.2}\text{sin. of } 16°\text{, nearly.}$$

And by setting the cross slide on an angle of 8° for a piece one foot wide in the center, the width at each end would be:

w Cos. 8° = .9903 of one foot.

* * *

The naval inquiry regarding the "Texas" will probably whitewash the line and condemn the engineers, as usual.

EVERY-DAY SHOP SUBJECTS.—2.

CHIPS.

KEEPING LATHE TOOLS—A FEED-ROD KINK—ROLLING UP OVERALLS.

You can often tell a machinist's capacity by the way he keeps his lathe, although you can occasionally get left in this respect. But as a rule, when a lathe has tools piled all over the bed, between the shears and on the tail-stock, you can depend on finding a man who isn't a first-class machinist. At times it may be the fault of the proprietor in not supplying a lathe-board, and this may be the case generally, but some men will not keep tools on the board even when they have one. This can be made of almost anything; a board with two cleats nailed to the bottom to prevent slipping off the lathe, or it may be an elaborate affair with little cupboard arrangements, red paint and brass hinges.

The one shown in Fig. 1 is a very fair arrangement, not expensive nor hard to make, and will give good satisfaction. It is made of an inch board of the required size (14 x 18 inches is very convenient) with edges raised about an inch and neatly beveled, and of course cleats on bottom to prevent slipping. At the back is a narrow shelf, about four inches wide, raised five or six inches from the lower board, with about a dozen holes at the left for centers of various kinds. This is particularly for the tool-maker, who is supposed to have quite a number of centers for various purposes, and this is about the safest way of keeping them so as to preserve the taper shanks from being bruised and thus affecting their fit and truth when in the lathe. A lathe-board like this will be found very handy for anyone, although for plain lathe work the shelf for centers can be dispensed with.

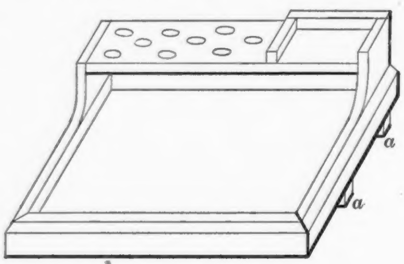


FIG 1.

It's mighty convenient, in facing off work, to be able to feed the carriage just a trifle toward the work, not too much, but just enough. The usual way of doing this is to throw out the rod feed and lock the carriage to it, then by turning the rod slightly by hand, you can produce any movement you wish. This is rather hard on the hands at times, and the knuckles often interview the lathe bed too closely for comfort, which isn't productive of edifying remarks.

Some men make a wheel as in Fig. 2, which has a feather at *a* and is put on over the end of the rod, toward the tail stock, as it is used at that end almost entirely. This gives a better grip and is handier in every way, besides being inexpensive.

Another and perhaps handier form, which a young chap of my acquaintance devised, is shown in Fig. 3. This is in halves and

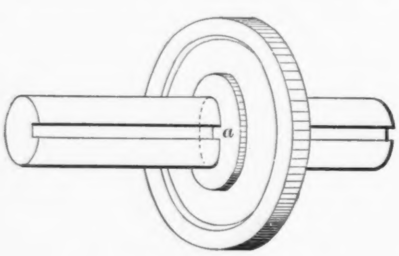


FIG. 2.

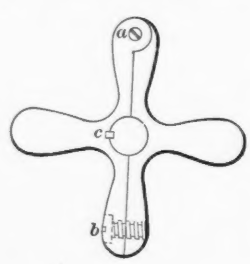
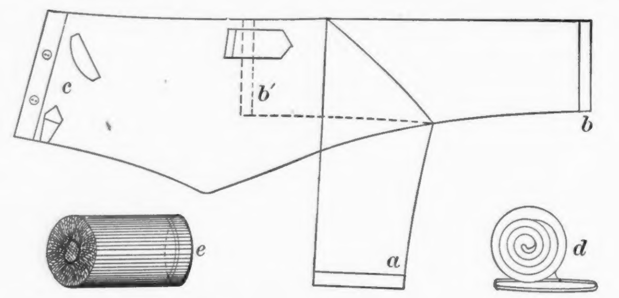


FIG. 3.

hinged at *a*, as shown, has a feather *c* and is clamped by screw *b*. It is an easy fit on the rod—same as the other one—so as to be easily moved along to the desired point. Either of them are handy little lathe kinks that are especially appreciated by those who have much facing work to do.

One of the annoying things about facing is to have the tool draw into the work, taking the carriage with it and often ruining the piece. The best cure is to make the tool with as little side clearance as possible, 5 degrees is ample. It is usually excessive clearance that starts the trouble. Then the slack in the carriage is an aid to this trouble and can be avoided by carefully taking up all slack before feeding in, and if necessary holding the carriage back by hand (with the regular traversing handle) when racing off. Or a weight can be arranged to do this if necessary. However, if the tool is made right, it will be ample precaution, as it is the main cause of the trouble.

I saw a little overall kink the other day that has some good points and is one that can be used every day, or at least on cleaning-up day. The fellow I saw just laid his overalls out on the bench, folded leg *a* over it at right angles as shown in the sketch, then leg *b* folded to *b'*, as seen in dotted lines. Then he began



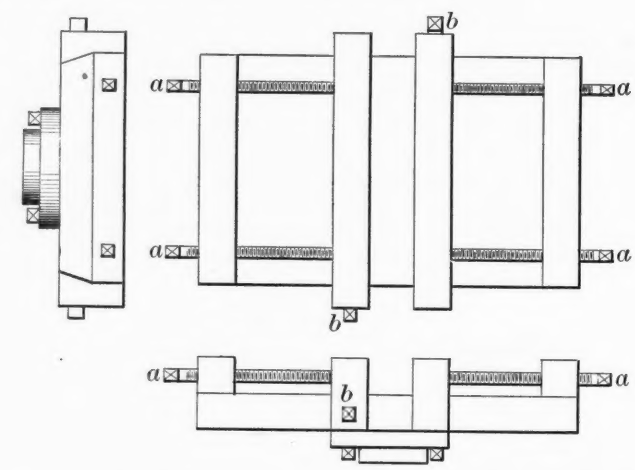
to roll up from *c* until it is like *d* at the the lower right hand corner. Then he took leg *a*, which is loose, and fold back over the roll *d*, just as you turn a stocking over your foot—if you do it that way. This makes a very neat roll to carry and it is handy to stick a monkey wrench, or cold chisel, into the roll when going out on a repair job.

* * *

A HANDY CHUCK.

F. H. JACKSON.

The chuck shown in the following illustration will be found a very handy attachment to any lathe, as it will hold a variety of pieces that are troublesome to chuck, and will take the place in many shops of the expensive two-jaw chucks.



The illustration is so plain that it hardly needs an explanation, so I will only say that as shown by the dotted lines, the sliding jaws shown in the figures fit over beveled edges and are clamped, after the adjusting screws are tightened, which holds all very solidly. There is enough side play in the jaws to hold taper pieces, etc.

The chuck shown was made especially to hold square nuts to face, bore and thread in lathe, and was found to be very efficient, and I think readers of this paper will find the time used in constructing such an attachment not thrown away.

* * *

ONE of the most sensible papers we have read, on the selection and treatment of street railway employees, was presented by Mr. W. F. Kelley, superintendent of the Columbus Street Railroad. After speaking of the kind of men who are desirable, he concludes that you cannot get men "who will remember and obey several dozen rules and be models of all the virtues in the bargain, for $2.00 a day." He protests against laying men off as punishment, and the general tenor of the remarks point to a somewhat similar system to that inaugurated by Mr. G. F. Brown, of the Fall Brook Railway. Treating employees as human beings instead of machines smooths over many of the difficulties. The only objectionable feature of the paper is in regard to not hiring men whose ideas on social questions differ from the majority. This has nothing to do with the work they are hired to perform.

FROM ACTUAL PRACTICE.

ABOUT WORM GEARS.

"MILO."

"That seems to be a good paper, but what I want is some kind of a book that will explain how to figure worms and worm gears. Suppose, for example, that I have a worm gear with a given number of teeth, and I want to make a new one with a few more teeth in it to run with the same worm; how can I find how large to make it? There are several mills near here and only one gear cutter. We make quite a number of such gears, and we are all having the same trouble. Several who consider themselves experts have tried to figure them without success."

This is the tale of woe that I heard from the boss mechanic of a mill when I called upon him one afternoon. Isn't it strange that a man will search so long for a book that might cost several dollars just for one problem in it that sticks him when there are so many good, cheap papers that have a column devoted to answering just such questions free of charge, without even asking if the questioner is a subscriber?

Thinking something must be wrong if the experts could not figure them, I determined to investigate. I asked to see one of the gears and was given one with 52 teeth. It was thin and badly worn, and measured about $2\frac{1}{2}$ inches, outside diameter. By subtracting the depth of space on one side from the outside diameter I decided to call the pitch diameter a little less than $2\frac{7}{16}$ inches. The worm was said to be cut ten threads per inch, and I tried to harmonize the sizes and pitch, but could not do so, and wondered if my figuring, which has grown rusty of late, was at fault.

Next I went into the mill for further investigation, and was shown a large number of them in use, most of which were badly worn. Selecting the one having the coarsest pitch, which happened to be in good condition, I found that the worm gear had 35 teeth and the worm two threads per inch. I figured out the size of the gear by the same method used on the first, then measured the gear and it corresponded with my figures almost perfectly. Next I found one exactly like the first sample given me, except that neither the worm nor worm gear were badly worn. But when I came to measure the worm, the threads proved to be about $\frac{9}{64}$ of an inch apart, or about $\frac{1}{7}$ of an inch from center to center, instead of $\frac{1}{10}$ ($\frac{9}{64}'' = .140''$, $\frac{1}{7}'' = .143''$, only $.003''$ difference). Calling the pitch of the worm seven threads per inch, I figured for a gear of 52 teeth, and again the figures tallied almost exactly with the measurement of the gear. I was convinced that something was wrong with the practice somewhere. Going from one machine to another, I examined the gearing on each. The trouble showed plainly. No wonder the experts could not make their fixed rules produce figures for gears to correspond to those in use. The gearing in question was used similar to the change gears on a lathe, the distance between centers being adjusted by means of a slot, so that larger or smaller gears could be used to obtain the required speed. In some cases the speed desired would be such that a gear to run with a seven-pitch worm would be too large for the place, so gears and worms of finer pitch were provided.

Now the worms were very short, some of them having but little more than one revolution of thread, which made it very easy, after they were so badly worn, to run a ten-pitch worm with a gear that was originally intended for seven or eight pitch, and as the worm had little work to do except turn the gear around, the difference in the pitches was gradually unobserved until entirely forgotten. When a change was made and they would not run, the pitch of a new worm was found by trying a tap into the teeth of the worm gear or some such method. If a new gear was wanted it was made by cut and try or guess work, aided by reference to the one on hand which came nearest to having the right number of teeth.

I have simply mentioned circumstances that interested and amused me when seen in actual practice. Now I will try and explain how I figured out the problem, hoping that others who are having the same trouble may get an idea from it that will help them.

Problem 1: To find the diameter of a worm gear of 52 teeth, to run with a worm having seven threads per inch.

In the first place it should be remembered that there should be as many teeth per inch on the circumference of the pitch circle as there are threads per inch on the worm. In other words the distance from the middle of one thread to the middle of the next on the worm is the circular pitch of the worm gear. Therefore, if the worm measures $\frac{1}{7}$ of an inch from the center of one thread to the center of the next, the circumference of the pitch circle of a gear having 52 teeth to run with it, would be $52 \times \frac{1}{7} = 7\frac{3}{7}$ inches. Divide this circumference of the pitch circle by 3.1416 and you obtain the diameter of the pitch circle. $3\frac{1}{7}$ instead of 3.1416 would be near enough for practical purposes, but perhaps I would never have thought so if I had never seen the gearing that prompted the writing of this article. I use common fractions and ready methods here for the benefit of those who may not understand decimals clearly. Those who are better posted can understand it just as well.

Another way to find the pitch diameter is to divide the circular pitch by 3.1416, which gives the corresponding diametral pitch, then multiplying this diametral pitch by the number of teeth as in ordinary gearing, gives the pitch diameter; the circular pitch having the same relation to the diametral pitch that the circumference of the pitch circle does to the diameter of the pitch circle. I like the last method best because it saves work where several gears of the same pitch are to be made, but having a different number of teeth.

Problem 2: To obtain from a sample worm gear the size of a gear having a larger or smaller number of teeth that will run with the same worm.

Measure the diameter of the sample gear from the top of one tooth to the bottom of the space on the opposite side. This gives the pitch diameter very closely. Divide this pitch diameter by the number of teeth on the sample and we get the diametral pitch; then by dividing the diametral pitch thus obtained by the number of teeth in the gear to be made, we obtain its pitch diameter. It would be well to multiply the diametral pitch in a job of this kind by 3.1416, which would give the circular pitch, and if it was any regular pitch and there had been only a slight mistake made in measuring it, the error would be more readily seen, as shown in the case of the $\frac{9}{64}$ and $\frac{1}{7}$.

The method of obtaining the circular pitch just mentioned also serves to find the pitch of a worm to run with a given gear.

The approximate outside diameter of a worm gear can be found by adding the depth of the space on the worm or worm gear to the pitch diameter.

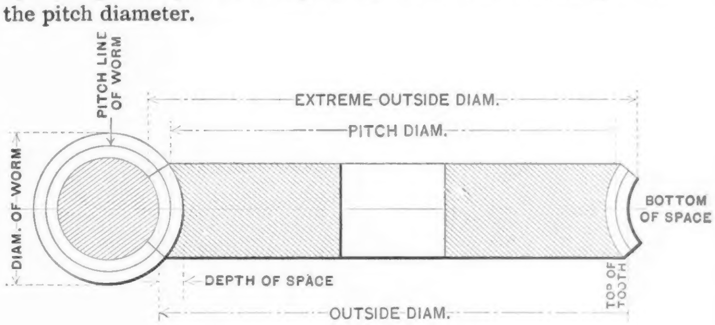


FIG. 1.

Fig. 1 explains itself. Where a worm gear hollows out as shown, the extreme outside diameter can be found by a sketch drawn to scale.

* * *

ACCORDING to all that can be gathered at this writing, the sinking of the battleship *Texas* at Brooklyn, evidenced a blunder of construction that would send the designer of a nine thousand dollar tugboat for service on the upper Hudson, looking for another job. By the current accounts an ordinary machinist understands that the yoke for the valve stem broke, and that the breaking of this yoke permitted the sea valve to open and flood the vessel until she quickly settled in the mud. Now if, instead of that, the breaking of this yoke had provided that this sea valve should have closed the more firmly, the battleship would not have sunk.

As before intimated, the builders of the little tugs know better than to put in an arrangement by which, through the breaking of a valve yoke, the boat must be fished up out of the mud. Suppose it is argued that in case the valve was self-closing, the breaking of a yoke would cut off the water supply. The answer might very well be, put in two main sea-cocks, either of them ample. A sea-cock is a rather simple affair, and a dozen of them would cost less than one court of inquiry, to say nothing of the bills of wrecking companies.

H.

CRANK-PIN BRASSES.

FRANK GLEASON.

Perhaps more petty trouble in starting up steam engines from fifty to two hundred and fifty horse power comes through an honest endeavor to do the work of fitting the crank-pin brasses *too well* than from any other single cause. I refer now to engines upon which all the work is first class. Machinists who do the shop work of such engines—the "best work"—are rather frequently made aware of the trouble that beset the erector in his best efforts to induce a crank-pin to behave itself, and mentally resolve that the next brasses they have anything to do with shall be scraped to the most perfect bearing they know anything about, which will make the troubles of the erector a little greater, and so it goes. Scrape the brasses so as to get more exact bearing surfaces right from the start, the fitter-up reasons, and there can be no trouble, not if Bill gets everything in line.

Pages have been written on that exact bearing part of the subject that would a good deal better have been printed in Greek—pages all about reducing friction, increasing friction and the like. Personally I would not give anything for all the speculative theory on friction ever published, anyhow. What I like to hear is what someone who has got every-day results to talk about says.

I believe that all the *fine* work that is put on the bearing surfaces of crank-pin brasses that have been correctly bored, is work considerably worse than wasted. Unfortunately, about all we know of crank-pin brasses at best (so far as fit is concerned) is that if they are fitted real fine in the shop—as the word "fine" is commonly understood—finely fitted to pin and strap, they can generally be depended upon to give trouble, and the reason is plain enough. The expansion of the two metals (brass and iron) is not alike, and when the brasses warm up a little, as they inevitably will, they bind the pin from *a* to *b*, Fig. 1. And the worst of it is this binding effort is cumulative. The warmer the brasses the more disastrous the results, even if we assume that the brasses and strap heat evenly, which we are not at liberty to do.

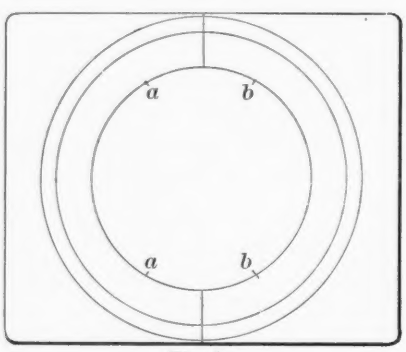


Fig. 1

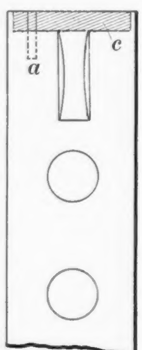


Fig. 2

Brasses are sometimes bored considerably larger than the pin, but this I do not believe to be the best remedy. No one in the world can tell just how much larger they should be bored to prevent seizing at the joint, and at the best the fit to the pin is a very imperfect one. I believe that this is one of the cases where a *rough job* is the best. Mind, I do not mean a job done by a rough workman, but a rough job done by a fine workman. The best success I have had has come from boring the brasses just sensibly large and then filing them with a half-round file—not too fine a one—lengthwise of the bore at *a*—*b*, filing more at the joint and gradually "running out" at *a* and *b*. How much to file away is all a matter of judgment and not of measure. But there are a good many instances in which a machinist will guess considerably closer than the finest splitter of hairs can measure; this is one. The operation of filing may have to be repeated after running a few minutes, or it may not. The stickler for smooth and otherwise exact surfaces may protest against this uncertain roughing-up business, to which protest there is not the least objection. Someone is bound to object to anything.

It is a mistaken idea, so far as my experience goes, to assume that a new engine of considerable size shall go on to its foundation and be ready for its full load at once. I believe, however, well the rod brasses behave in preliminary brushes, before starting for continuous running, the rod should be taken down for examination of pins and brasses. This will, more likely than not, save delay during the first few days running.

If the pin gets roughed up while getting ready to run—or afterwards, as to that—smooth it up as well as possible, using one of the brasses as a templet and finally "lay the grain" in the direction of the length of the pin with a piece of emery cloth only moderately fine, being careful, of course, to wash away any emery that may adhere to the pin.

Speaking of connecting-rods reminds one of the difference in opinion there is as to stub-ends. I once had the designing of several rods for engines up to 250 horse power, and, after speculation, settled on the locomotive type of stub-end and strap, with the only difference, so far as I know, of using the steel plate *c* as in Fig. 2. This plate was $\frac{3}{8}$ inch or $\frac{7}{16}$ inch thick. For this piece the end was slotted and the piece nicely fitted to the slot. The dowel-pin *a* served no purpose other than to prevent a careless engineer from putting in liners, when they became necessary, in the slot instead of next to the brass. The bolts were of steel, the holes being reamed $\frac{1}{16}$ inch taper to the foot. This style of stub-end and strap is not particularly handsome, but it is one of the kind that never gives one uneasiness.

* * *

MOULDING PRESS ROLLS IN DRY SAND.

GEO. O. VAIR.

During a visit in a foundry making paper mill machinery, the writer noted how they were moulding the press rolls, and it has occurred to him that a description of the methods employed therein might interest others, and give ideas that will be applicable on other jobs, especially the manner of making and securing the core. The rolls are finished to an exact size their entire length, and require to be perfectly sound and clean.

The accompanying sketches may not be exactly correct, but will be found near enough for practical purposes. The base of iron flask A, Fig. 1, is cast with bottom on, and a hub B in center to receive the core barrel. The bottom end of the core barrel has a collar G, shrunk on, which forms a seat for the core on hub B. It will also be seen there is a solid stub welded in the end of the core barrel, with taper end, and thread on same for nut C. The core barrel consists of 2 inch outside diameter heavy steam pipe. The pipe is perforated to allow the gas to escape from the core, while the roll is being cast.

The method of making the core is as follows: The ends of core at O O being made of loam, the first operation necessary is to wind on to the core barrel, to the required distance—from extreme ends to wood disks X X—a slight thickness of hemp, after which the loam is swept on in the usual way. The body, or chamber part of the core, is made in halves, from a core box. Ordinary core sand mixture is used for the halves, or the dry sand mixture would answer the purpose.

At E E, Fig. 1, is shown two wood discs about 5 inches in diameter by $2\frac{1}{2}$ inches thick, which are placed on the core barrel previous to making the loam ends O O. Seats for these discs are made in the chamber halves of core; and when the cores have been dried, the core barrel with the loam ends and discs on are laid into one half of the chamber part of core. Previous to placing the remaining half of core on, wooden keys or wedges are then driven into the key-seats in the discs; the object of which is to carry the core on the barrel, and hold the chamber core to its place in mould. The whole core is nicely secured by nut C, Fig. 1.

The key-seats mentioned above should be cut in the discs opposite to the grain of the wood, otherwise they would be liable to split the discs.

To hold the two halves of chamber part of core together, twisted tie wire was used. By sawing around the core to let the wire in enough so it could be protected from the iron, by covering with sand, and then black-washing, seemed to answer the purpose of holding the two halves together. But I think the method of securing a core of this description would be better if accomplished in the manner shown in Fig. 2, which consists of a chain link wedged over the cross rods in the core.

As the diameter of the core through the neck of the roll is only 3½ inches, the core rods used had to be nearly straight, so as to admit of the core and core rods, being easily removed when cleaning the casting.

The pouring gate as shown, cuts into the mould about half way down the lower neck, and is set at an angle so as to cause a whirl, or rotary motion to the iron while being poured. Sometimes these castings are gated from the top instead of at the bottom, with very little difference as to results.

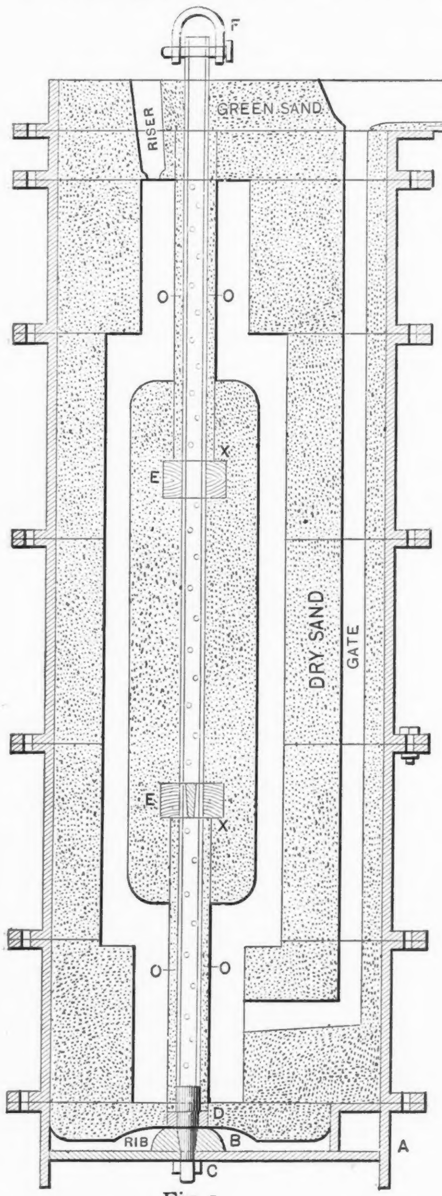
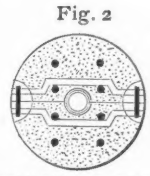
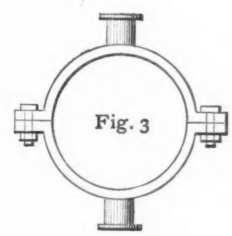


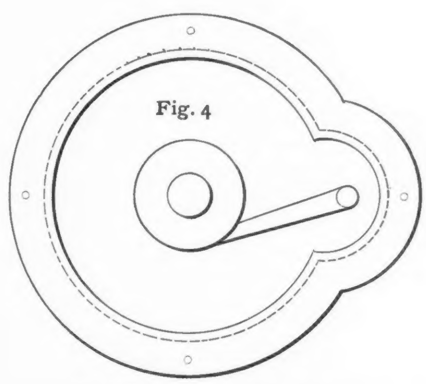
Fig. 1
SECTION OF ROLL MOLD AND FLASK

Fig. 2



SECTION OF CORE





PLAN OF FLASK AND GATE

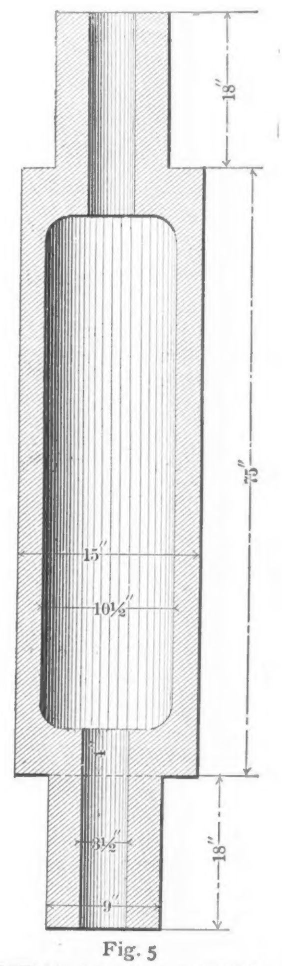


Fig. 5
SECTION OF ROLL CASTING

MOLDING PRESS ROLLS

Fig. 3 represents a cast iron rigging they used for lifting and setting the core in the mould. It was clamped around the large part of the core, using rags or waste between it and the core to protect the latter from damage. The clevis at F, Fig. 1, would be an improvement on the rigging spoken of, and such is generally used in handling cores, as shown here.

Fig. 4 shows plan of flask and gate. At Fig. 5 is seen longitudinal section of roll casting.

The writer did not inquire the object of using the style of flask as here represented in Fig. 1, but I think the flask for a job of this description would be much better if constructed in halves, also pattern to be made in the same way, thereby saving considerable time in moulding, and it would make no alteration necessary in the manner of making and securing the core.

* * *

"THE WIDE BELT HERESY."

Robert Grimshaw.

I must take issue with Mr. W. L. Cheney in his article under the above head, on page 10 of the September number. The facts, as proved by about 2,000 tests made by me, and many of which have been published in various technical papers from 1879 on, show that a wide belt will pull more than a narrow belt not only "when it is stretched tighter," but when it has the same tension per inch of width.

Here let me remark that the use of the expression "stretched tighter," used by Mr. C., is misleading, as it does not say whether he means tighter per belt, or per inch of width.

The advantage of a wide belt is that it enables a good surface of contact on the pulley, without undue pull on the bearings. The laws of friction governing slide-valves and cross-heads, which never get enough pressure on them to deform them, do not apply in the least to belts, except once in a while, when they apply upside down. Thus for a slide-valve the friction increases with the load per square inch. Friction of the valve corresponds with grip of the belt, and load per square inch on the valve is represented by tension per inch of width (*not* per square inch) of belt. Now up to a certain point, increase of tension per inch of belt width increases the grip and the drive, but after a certain amount of tension belt width is reached, a leather belt on a cast iron pulley will drive less and less as the tension per square inch is increased. I was the first to point this out; I did so some fifteen years ago. The reason is plain. Up to a certain point, increase in tension per inch of belt width, beds the belt down better and belts to the pulley face and increases the "grip" on friction. Beyond that point, the character of the belt surface is changed, it takes on a glaze, as it were, by reason of the excessive pressure. A glazed leather belt surface will not drive so well as an unglazed one. For this reason many new leather belts will drive better *at first* with the flesh side next to the pulley (at any rate this is so on

cast iron pulleys), and then afterwards with the grain side. I was the first to point out that in the long-continued controversy between millwrights as to whether the flesh side or the hard side would drive the better; both were right and both were wrong; for the flesh side usually drove best, of a new belt, and the hair side of an old one.

I have the disadvantage of being 4 000 miles from my records, which are boxed up in "God's country;" but I have no doubt that the New York Belting & Packing Co., the Gutta Percha & Rubber Mfg. Co., Sayre & Co., of Utica, Bradford, of Cincinnati, Schultz of St. Louis, Gandy of Baltimore, and several other belting manufacturers, also Geo. V. Cresson, the Taper Sleeve Pulley Co., the Medart Pulley Co., the Dodge Mfg. Co., and other pulley manufacturers, for all of whom I made tests in years gone by, have figures at hand which will bear out what I say.

From my "Little Belting Catechism" (which the Gutta Percha & Rubber Mfg. Co., of 35 Warren street, New York, reprinted in 1886 for free distribution among its customers, and copies of which can probably be had for the asking, by any belt user), I quote the following, page 23:

"Q. How is it that the well known rule that friction is independent of area of contact does not apply in the case of belts?

"A. Because where a hard block slides on a hard plane there is no deformity of surface; whereas increased tension on a belt does deform the surface; and as the greater the surface in contact the less proportionately the weight tending to deform the surface of a given area; the greater the pulley diameter the greater the coefficient of friction for a given linear belt-speed. This is entirely independent of any ridging of the belt surface next the pulley, due to sharpness of curvature around a small pulley."

From page 21 of the same little book I take this question and answer:

"Q. What special class of belt should be used for driving dynamos?

"A. Very wide belts with slack tension, running on pulleys of large diameter, and with as much arc of contact as possible."

From page 13 I extract the following:

"Q. Which drives the best, wide belts or narrow ones, and why?

"A. Wide ones, because they have more gripping area.

"Q. Is the driving power directly proportional to the belt width?"

"A. No; because in many cases the wide belt will not bed down well, and two three-inch belts might drive better than one six-inch.

"Q. In what cases is this especially true?

"A. With light tensions. Thus, a six-inch four-ply rubber belt with 180° contact, 195 pounds tension, on a thirty-inch wrought iron pulley, had 442 pounds grip; while a twelve-inch four-ply belt with 400 pounds tension (which is rather more per inch of width than in the other case) had 878 pounds grip; rather less than double 442 pounds.

"Q. What can be said about width of belts for driving circular saws?

"A. In nearly every case the belts or the pulleys are too narrow and the bearings get heated. No circular saw for ripping should have a flat belt on an iron pulley narrower than one-third the saw diameter; the pulley diameter, if of iron, should equal the belt width.

"Q. What is the general effect of increasing the belt width?

"A. Beneficial, especially with heavy tension, lessening the stress per inch width of fastening, and allowing a reserve of driving power."

I thoroughly agree with Mr. Cheney that belt speed is a good way of getting power. It is better than belt width, because cheaper, and better adaptable to most modern machine speeds; but when he says "it is belt-speed and not belt-width that transmits power," he goes too far.

Where he sums up and says "The only reason why a wide belt will pull more than a narrow one is, that it can be strained tighter than the narrow one," he is not in the same county with the facts. The reason is because it need not be strained so tightly, either per total belt width, or per inch or width, thus making less pull on the bearings and not only giving more "grip," but causing less loss by friction of bearings.

An analogy with the belt width question may be found on most American railways—where a four-wheeled coupled engine will pull more than one with only a single pair of drivers and the same *total* weight on drivers. The reason lies in the irregularity of the track, causing imperfect contact. If the track was laid on a granite foundation, and shimmed up to a dead level, a single pair would do better than two pair, with the same weight on drivers, because there would be less friction, and the cramping caused by the parallel rod would be lacking; but as it is, engines with but a single pair of drivers would find it hard work getting away from most of our stations and climbing many of our grades.

I believe in as high belt-speeds as the relative practical diameters of driver and driven pulleys, and the relative practical speeds of the two will permit; but there are limits to the size of fly-wheels and to the maximum diameter of driving-pulleys; and there are also limits to the maximum diameters of driven pulleys. To use higher belt speeds with given belt diameter and other conditions equal, both the driving and the driven pulleys must bear greater diameter; and this is not always practical, particularly where the shop ceiling is low or the pulley called for would be larger than the regulation size of hangers would take in.

There are many dynamos now running with 14-inch or even 22-inch pulleys, which would be much improved by blocking them up and putting on a 28 or a 24; but if they are now belted from an 8-foot fly-wheel on an engine making 280 or 240 turns to give the dynamo (less slip) 960 turns, doubling the size of the dynamo-pulley to give greater belt-speed would necessitate a 16-foot fly-wheel, which would not fit the engine; while halving the dynamo-pulley diameter and keeping the fly-wheel diameter the same, would mean running the engine at 560 or 480 turns. which probably could not be done.

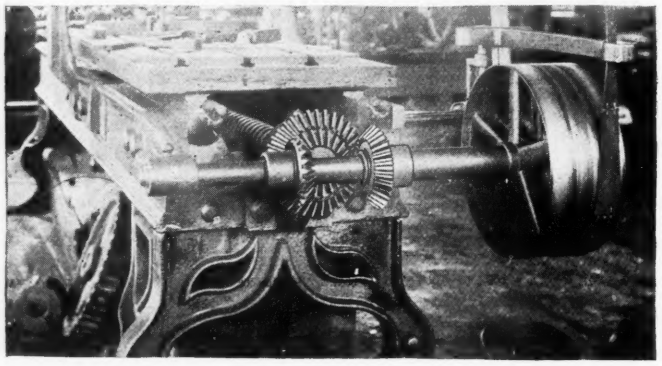
* * *

OLD TIMERS.

SCREW DRIVEN PLANER; NOT SELLER'S TYPE.

There are many young machinist's to-day who never saw an old screw-driven planer and who have doubtless wondered just how they were constructed. The view shown herewith gives a very clear idea of this and was taken in Gage, Warner and Whitney's shop—in fact, stood right beside the automatic gear cutter.

The bevel pinions on the cross-shaft at end of planer drive the screw in either direction, according to position of driving-belt. The right-hand pinion is fast to a sleeve, while the left-hand pinion is driven by a shaft running through this sleeve. The sleeve is driven by one pulley and the internal shaft by the other.



OLD SCREW DRIVEN PLANER.—REVERSING MOTION.

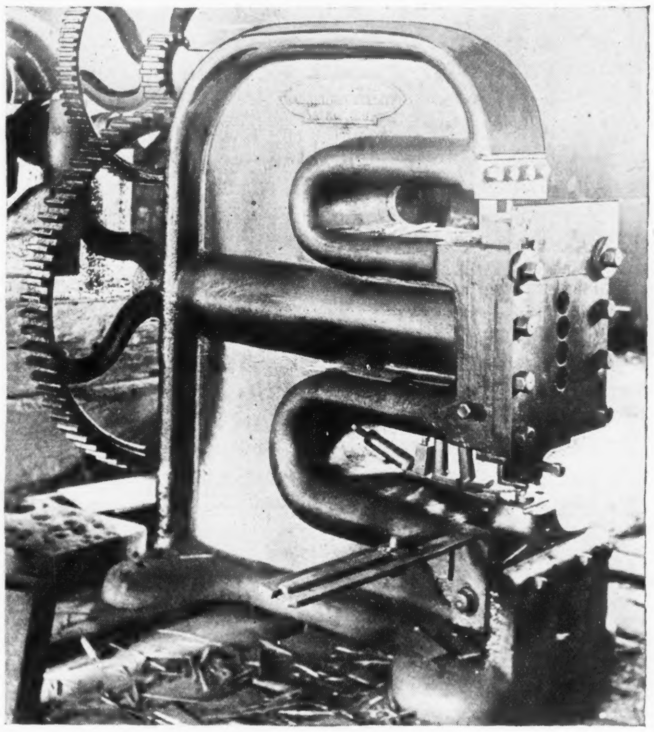
When the belt is as shown, on the outer pulley, it drives the shaft and left-hand pinion, which drives the screw in one direction by the inner gear shown, while the right-hand pinion, driven by the sleeve from the inner pulley, drives the screw in the reverse direction through the outer gear. Rather an ingenious method and one which has been used for years in different classes of machinery.

The antiquity of the planer is also attested by the design of the legs, whose bends and curves show plainly the change in ideas of machine design in the last twenty-five or thirty years.

COMBINATION PUNCH AND SHEARS.

This is another of the old Gage, Warner & Whitney tools, found in the basement of the old shop in Nashua, N. H. It is a combined punch and shear, but not in the regulation style which is in use to-day. The punch is at the bottom, the shear on top,

both being driven by the central shaft. This operates the punch on the down stroke and the shear on the up stroke, which is a rather unusual proceeding. The design is pretty well calculated to withstand the strains imposed by the work, and the architectural adornments which were so frequently used about the time this was built, seem to be lacking. Close inspection shows



COMBINED PUNCH AND SHEARS.

it to be provided with a stripper for the punch, as well as a distance gauge at the left; the latter is probably an after-thought, although this is not certain. The machine was evidently pretty well geared down, and can probably handle fairly heavy work. Like most of the other tools in the shop, it was taking a vacation at the time of my visit.

* * *

A BIT OF FOUNDRY EXPERIENCE.

L. C. Jewett.

How often in foundry practice the small and apparently little things will first trouble, then mystify, and finally worry the foreman moulder, while perhaps some small unsuspected omission or commision is the cause, or equally small thing the cure. I once knew a small job of about 5 pounds weight with a very fine tooth bevel gear cast in the end of the casting, that was taken to some three or four foundries, because the teeth in the gear would not cast perfect, as pattern was made to cast with gear in the bottom. The last foundryman turned the mould upside down, casting the gear on top, and got it the first and for all future time.

The sketches, Figs. 1 and 2, represent a small innocent looking casting. Nothing suspicious about it; in fact it would be considered a very dull boy who would strike a snag, moulding so plain and harmless a thing as it appears to be.

That and similar castings have been the cause of as much annoyance both to customers and the foreman of a certain jobbing foundry as anything they have had to contend with, until a remedy was applied and proved a cure. The bottom of the V required perfect soundness, as it was finished, and the slightest imperfection rendered it useless for the purpose intended, which delayed the use of it and soured and vexed the customers.

Fig. 2 shows in cross section the location of the defect, consisting of a ragged hole situated some $\frac{1}{8}$ or $\frac{1}{4}$ inch below the point of the V and midway in casting, as shown. Quite a number were made and passed inspection in the rough, to be condemned when finished. At first it was supposed to be a bubble from the thin point of green sand. That portion of mould was made in dry sand. No improvement.

Then a large shrink head was put on at A just back of the point of the V. Still no improvement.

They were cast on end with the thin plate of casting up and the jaw down, and as large a shrink head put on top as the full size that plate $\frac{5}{8}$ inch thick would allow; yet there was no improvement.

All were not bad, but 30 per cent. certainly were returned. After considerable machine work had been put upon them, the courteous relations between customer and foreman were fast becoming strained, as time was an important, in fact *the* important factor.

The usual character of the work made at this foundry required using irons of very soft character. There were few of this kind of casting required at a time, but when ordered it was of the utmost importance to cast them promptly, and no halts from start to finish. To make special heats or special charges were out of the question.

After resorting to and exhausting every art to prevent the supposed causes, such as blurring, dross, shrinkage, and signally failing, it occurred to the foreman that the diagnosis of this case had been wrong; the trouble was not caused by the above mentioned causes. The iron used was of the softest grades, rich in graphite and silicon, necessarily so from the nature of the work done. Iron high of silicon will expand at the moment of granulation and solidification. Consequently the foreman reasoned that the particular portion where the defect occurred was liquid longest, and as the solidified portions expanded, this spot was actually torn asunder.

Acting on this theory, small chills $\frac{3}{4}$ x 2 inches were placed on the nowel part of the pattern, where shrink head had been on the cope side located, the object being to accelerate that portion to solidify when cooling; and it did the trick to perfection; the chills were kept back clear of the finishing lines, so no chill in sur-

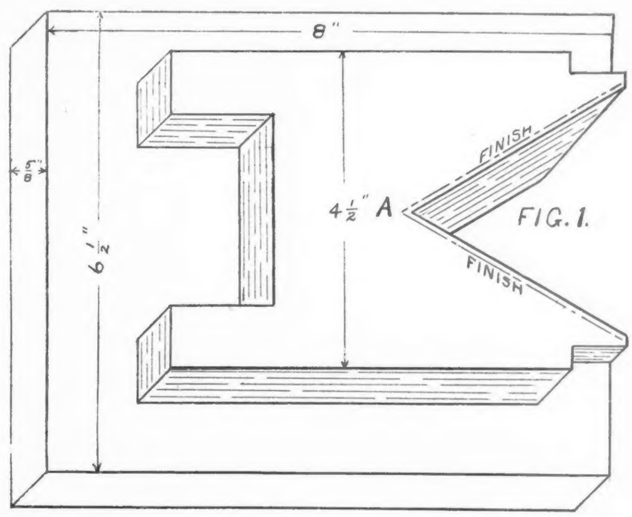


FIG. 1.

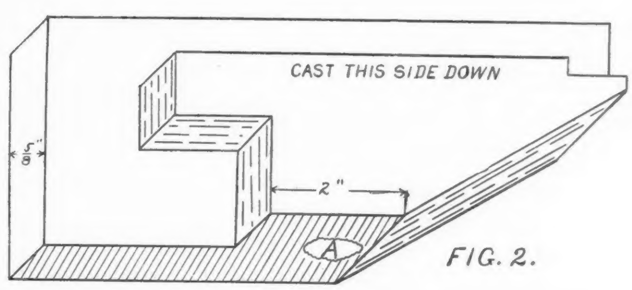


FIG. 2.

face occurred to interfere with finishing. There has not been a single imperfect one since, and some hundred or more have been made in this manner.

The use of chills to prevent drawing and cracking in corners in steel and malleable iron practice is a common thing, but I am not aware of this being resorted to in green sand practice, for purposes of this kind. It proved most effectual in removing a thorn from this foundryman's side.

* * *

The Gas Industries Co. will hold an exposition of gas appliances at the Madison Square Garden, New York, for two weeks, beginning January 25, 1897. This is the first exhibition of this kind to be held here, and it should be interesting to note the development of this line of engineering.

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WE solicit communications from practical men on subjects pertaining to machinery, for which the necessary illustrations will be made at our expense.

ALL copy must reach us by the 10th of the month preceding publication.

DECEMBER, 1896.

CONTENTS:

ALTHOUGH the revival of business is not quite so extensive as some of the daily papers would have us believe, it is fully as great as can be expected at this season of the year and represents a steady, healthy improvement, of the kind that continues to grow, and which is vastly more to be desired than a boom. Generally speaking, most other industries attain headway before the demand reaches machinery manufacturers, but their turn is not far off, and they may look forward with confidence to four years of prosperity.

What business men need now is a rest from politics.

HONESTY IN MAKING TESTS.

It is to be regretted that more dependence cannot be placed on some of the expert evidence and opinion that is given concerning tests of new devices or estimates of the cost of work, as the knowledge of a few instances of unreliable work makes one suspicious in all cases. A few instances of this character will be more effective than pages of moralizing and show exactly the kind of work that is being done altogether too extensively.

A certain steam-using specialty was given by its manufacturers to a well known engineer to test for efficiency, and also to be compared with another device for the same purpose. In the first plant selected, the device did not make as good a showing as its competitor, so this would never do for a report; and another plant, with conditions much less severe, was selected for the second trial. Here, according to the figures at least, the instrument in question made a little better showing than its rival. The report, however, compared the favored instrument at the *second* test, with its rival at the *first* test, where the conditions were entirely different; and this is the report that is being circulated throughout the country. While it probably contains no direct untruth, the concealment of the different conditions under which the tests were made, brands it as a deliberately false report, alike discreditable to engineer and manufacturer.

That this kind of a report is desired by some makers is evidenced by the following: An engineer of our acquaintance was retained to give an estimate on the value of an electric lighting plant which was about to be sold to the town in which it was located. The owners gave an inventory of the plant, and the engineer began by writing to the different makers of apparatus installed therein for prices of new machines similar to those in the plant. From these and other data he made his estimates, which were too low by several thousand dollars to suit the owners, who wanted to make something out of the town. The engineer was dined and wined, coaxed, and offered cash if he would add a few thousands to his estimate, and because he would not the owners refused to pay for his services. Another case was where a new smoke consumer or preventer was being tested, and on the result of this test depended the advancement of money by a capitalist for its manufacture on a large scale. A carefully conducted test showed that while the device was a very good anti-smoker, it decreased the efficiency of the boiler about 10 per cent., which would not be apt to help its sale if generally known. The inventor and his friends used all the usual persuasion in the shape of wine dinners and offers of stock, to induce the engineer to make his report favorable, and because he would not, tried to throw discredit on his ability as an engineer, and to otherwise injure him in his profession.

As long as men are weak enough to accept bribes or to alter their opinions for money or other considerations, we shall have reports of tests which are really valueless, but which probably help to sell goods to the unsuspecting public, to whom a test report, signed by some one with an M. E. after his name, will be a sufficient guarantee. And as long as inventors and others want to misrepresent goods in order to sell them, this kind of an official report will be in demand. On the other hand there are engineers who will make a flattering report of a device so as to be retained as consulting engineer for the prospective company that he hopes will be formed, and often deceives the inventor as well as the stockholders.

Fortunately, engineers of this type are not very common, for as a body they are reliant, self-respecting men who would not stoop to the actions mentioned; but as long as such false reports are made and circulated, the careful buyer or engineer should take pains to find out who made the test, and all the essential conditions, for if

these are not given in the report it loses much of its value. The sooner it is recognized that a report of tests in order to be of value must give the exact conditions under which it was made, and if compared with the test of another device, the conditions in each case, the better it will be for all concerned, relieving both maker and engineer from the possible imputation of dishonesty. Stripped of all technicalities, it is simply the old question of honesty against dishonesty, and as the former is always the winner in the long run; the engineer who makes an honest test regardless of wine dinners or shares of stock, is the one who will be in demand by reputable firms.

* * *

MUCH NEEDED PATENTS (?).

We make a few extracts from a spread-eagle edition of the *National Recorder*, of Washington, D. C., which from certain premium offers, appears to be published in the interest of John Wedderburn & Co., the patent attorneys of Washington, who offer premiums for the most practical (?) devices presented to them to be patented:

1. A revolving engine piston.
2. An engine requiring less steam than any now in use, and at the same time developing equal power.
3. A device to use the exhaust steam over again in engines. This should be a bonanza.
4. A device for forcing water into boilers that will not get out of order, and at the same time be cheap and simple.
5. A cheap steam whistle that will answer as well as the large costly ones now in use.
6. A ball-bearing device for bicycles that can be easily adjusted, and that when once adjusted, will remain so.
7. A pneumatic tire, as good as those now in use, that can be sold for about $2.50 per pair. Those now in use cost $14.00 per pair.

These are but a few out of several hundred devices, which the world is supposed to be anxiously waiting for, and for which they will load the lucky inventor with honors and riches beyond imagination. In fact humanity has a crying need registered for every one. Who of our readers will help wipe away these tears?

Let us take a look at the list. The first is a little indefinite and leaves one in doubt as to whether a piston is needed for a revolving engine, or simply a revolving piston for a plain every-day engine. Our ignorance fails to perceive the dire necessity of making any more loose parts in a cylinder than we now have.

The second request is the most sensible of the lot, but from all appearances this is being looked after by the best builders, who save a little here and a little there, until the total becomes noticeable. This kind of saving doesn't come in big jumps by the use of Blixer's anti-friction valve ointment and the like.

No. 3 is like coaxing the water which runs over a dam, into crawling up the back side and then doing it over again.

The fourth was evidently written by a man who doesn't know a boiler from a saw-log. When we consider that an injector is, at best, a piece or pieces of brass with holes bored through them, we think the simplicity part is answered, and as for cheapness—well, they are almost given away for chromos at present. Practically the same remarks will apply to No. 5.

No. 6 will be interesting to bicycle builders, who have been for years claiming the very features here asked for. If they had only consulted the writer in question we should have seen bicycle catalogs much more meek and lowly in their language than at present.

The next one is about the same in tone and reliability. The best of tires retailed for $12. per pair, all the season, and can probably be had for less at present, while there are tires, which are said to be guaranteed, retailing as low $4 per pair.

It is not with any desire to cast reflections on the paper in question, but to utter a word of warning to our readers, that this is written. Most of them are ingenious and enterprising mechanics, who are probably devising new ways and means of doing work, and some of them may be thinking of applying for patents. To such we say, go to some reliable attorney on whom you can depend, pay him a fair price for his services and be largely guided by his advice. Don't patronize the no-patent-no-pay man. It costs a man just as much to push an unsuccessful claim as a successful one, and he should be paid for it. If he is honest, he will not advise patenting a poor thing; the other man doesn't care as to the value if he gets a patent—and his fee. A glance at the *Patent Office Gazette* will show many of this kind.

A device may be new, admirably adapted for its particular work and yet not valuable enough to patent, because its use would be so limited as to make it unprofitable commercially, and this side should always be considered.

* * *

NOTES ON FOUNDRY PRACTICE.

PETER J. CONNOR.

The variety and number of castings produced in the majority of iron foundries requires the exercise of good judgment on the part of those who have the management of such departments, and the employment of a good class of men, along with appliances which represent the improvements of our day, in order to successfully produce the best class of work in an economical manner. Where the castings to be made are of such sizes as can be conveniently handled, there does not enter into the consideration of their cost the same elements which exists when the castings are of great size and weight.

The moulding machine is one of the important factors in foundry practice in these days, and where the nature of the work is such that they can be used to advantage, they will eventually be more generally adopted.

The relation which the foundry bears to the machine shop is such that the quality of the products of the foundry have a very important bearing upon the amount of work turned out of the shop. The class of castings required by one concern may be of a kind that would not be of service to another, and the mixtures employed must be determined by those who have knowledge of the wants of the users of them. Many shops have their castings made by jobbing foundries, for various reasons; some because they do not use enough to justify them in running their own foundry, while those located in the large cities may do so on account of the cost of ground room. When the castings are procured from outside parties it relieves the concern of the responsibility of the foundry branch of the business, and they can generally procure such grades of castings as they desire.

Where the works are large there must of necessity be considerable attention paid to the system of keeping account of weights of castings, prices paid for making them, and records as to when they are finished or under way.

The Niles Tool Works Co., Hamilton, Ohio, have a separate office department for this purpose; the lists of castings are made up in the drafting room and sent to the time-keeper's (or cost accountant's) office, there to be entered in the foundry order book, and all records concerning the castings until they are delivered to the machine shop are kept in the foundry office books.

If for any cause it may be necessary on account of defects to duplicate a casting, an order is made out stating the causes for such action, and if changes in the pattern are required they are made at once.

The relations existing between pattern shops and foundries are such that the foundrymen's views are often of great help in determining the manner which patterns are to be made, and suggestions from that source may be considered and acted on.

The general improvements in the buidings used for manufacturing plants have resulted in a beneficial way to the foundry, and many of the new buildings for that purpose are fully up to the standard.

Better methods of lighting and ventilation have been provided, but in regard to heating there is much yet to be done for the comfort of the employees.

The literature upon the subject of foundry practice which has appeared in the last few years has been of great benefit to those connected with the machine business, and there is evidence that interest in such subjects is on the increase.

We may rest assured that the foundry, which forms such an important branch of industry, will profit by the progress and intelligence of the future as it has in the past.

* * *

THE Street Railway Review, published by Windsor & Kenfield, Chicago, Ill., with its customary enterprise, announces a foreign edition, beginning with January 1897, which is to be a quarterly for the present. This is to go to the officers of the English and European tramways, who are adopting many of our methods as fast as circumstances will permit.

VALVE GEARS.—2.

E. T. ADAMS.

Having completed, in the last paper, the design of the valve, the next step will be to provide a mechanism to give it the required motion.

Practically all the work done by the steam on the piston is utilized in turning the shaft, and from this source of motion and power we may, conveniently, take the power required to drive the valve. We start, then, with a rotary motion at the shaft, which must be transformed into a reciprocating motion at the valve, and the same combination of crank and connecting rod, which serves to convert the reciprocating motion of the piston into the rotary motion of the shaft, is at once suggested as a suitable means of changing this motion of the shaft back to the required motion for the valve.

For practical reasons the crank which drives the valve differs *in form* from the main crank, and, in fact, is called *an eccentric*, but in effect it is simply a crank with the crank pin enlarged to encircle the shaft, and the effective arm or length of crank is

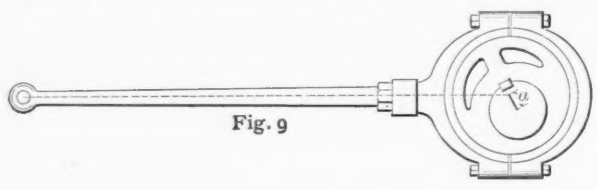


Fig. 9

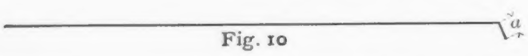


Fig. 10

simply the distance from the center of this crank pin to the center of the shaft. When the crank takes the form of an eccentric, this distance is called the *throw of the eccentric*, but in general the terms, "length of crank," or "throw of eccentric," both refer to the same measurement. Fig. 9 shows an eccentric with strap eccentric rod, &c., of a form suitable for engines of small size. Fig. 10 is a diagrammatic representation of the same thing.

In the present case we may make the arm "*a*," Fig. 10, ¾ inch, that is, we make the throw of the eccentric = ¾"; the travel of the valve in any one direction will then be twice this distance, or 1½ inches. This is evident, and if we draw a reference line through the center of the valve at "*y*," Fig. 11, we find that at *x* the center of the valve is ¾ inch to the left of this position, and at *z* it is an equal distance to the right.

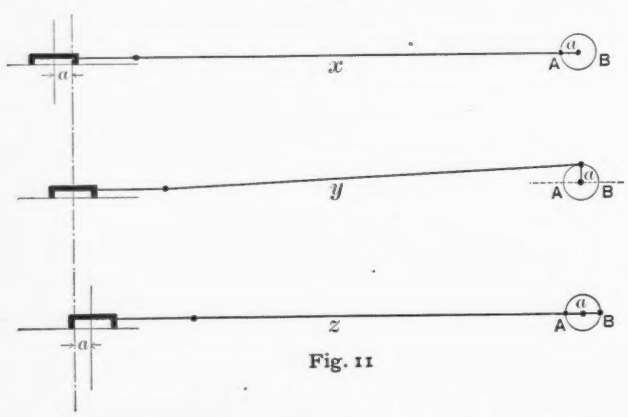


Fig. 11

When the center of the eccentric is at A the valve is at its maximum position toward the left. When this center reaches B the valve is at (*z*) its maximum position toward the right. These two points, A and B, in the path of the center of the eccentric are called dead points or dead centers, and we see again that when the center of the eccentric is located, as in "*y*," Fig. 11, midway between its dead centers, the valve must be very nearly midway between its two extreme positions.

It is evident that this will still be true no matter what form may be given to the valve; and, further, we see that we could double or treble the length of the eccentric rod. or we might increase or decrease the throw of the eccentric, still the center of the valve for this position of the center of the eccentric would be almost exactly midway between its two extreme positions. It would be exactly in its mid position except for an error introduced by the angularity of the eccentric rod, but, neglecting this error, which is very small, it is important to remember that the valve will be approximately in its mid position when the center of the eccentric is at 90° to A B, Fig. 11, or half way between its dead centers, and further, that these relative positions of the valve and eccentric are not appreciably affected by either the length of the eccentric rod and valve stem or by the form of the valve or the eccentric.

We shall see presently that the mid position of the valve can not be located at random, but we may secure the eccentric at *any* position on the shaft, and as the latter turns it will give a reciprocating motion to the valve, and then, by changing the length of the valve stem or eccentric rod, the mid-position of the valve may be located at any point desired.

It is desirable to have equal port openings for each stroke of the piston, since for each stroke equal quantities of steam are to be admitted to the cylinder, and evidently this condition is met if the valve when in its mid-position stands central over the ports, as in Fig. 12, with the steam edges, *m*, of the valve at equal distances from the edges of the ports. Now in Fig. 12 the steam edges *m* of the valve are just "line and line" with the edges of the ports, and the valve is evidently in its mid position, and the

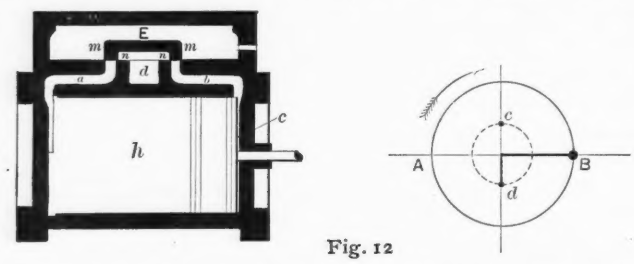


Fig. 12

center of the eccentric, as we have seen, should be midway between its dead points or somewhere on the line *c d*, Fig, 12. This will give the correct location of the center of the eccentric relative to the valve, but in order that admission; release and the other events in each stroke may occur just as we assumed they would when we drew the theoretical indicator card, it will also be necessary to find the correct position of the valve relative to the piston, and of these two relative to the crank, or of the center of the eccentric relative to the crank.

In Fig. 12 the piston is drawn at one end of its stroke, and as the slightest motion of the valve toward the left would admit steam through the passage *b* for the return stroke of the piston, it is evident that the relative positions of the valve and the piston are correctly shown in the drawing, and all that remains is to find the correct location of the center of the eccentric relative to the crank.

When the piston is located as in Fig. 12, the crank must be at

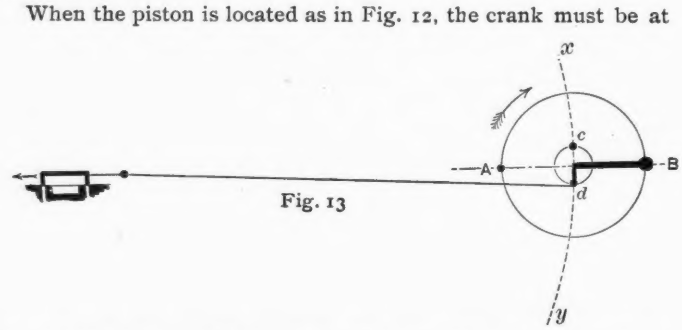


Fig. 13

B, and, no matter which way we conceive rotation to take place, it will tend to move the piston toward the left. If we assume that the shaft is turning in the direction shown by the arrow, and the center of the eccentric is located at *c*, it will tend to move the valve toward the right, while if this center is located at *d* it will tend to move the valve toward the left; that is, while the piston can only move toward the left, the valve can be moved either toward the left or toward the right, depending on which of these two locations we choose as the position of the center of the eccentric. We have seen that toward the left is the direction in which the valve should move, hence for rotation, as shown by the arrow, Fig. 12, the center of the eccentric must be at *d*, 90° ahead of the crank.

As a test of the accuracy of our work, let us see where cut-off will take place. With the crank at B, Fig. 13, and rotation as shown by the arrow, the center of the eccentric is at *d*, and as the valve is just ready to admit steam, it is also exactly in the position it must occupy at cut-off, with, however, this difference, the direction of its motion must be opposite for the two events.

We may consider for the moment that the valve is fixed in its position and see what positions it is possible for the center of the eccentric to occupy. In order to do this, suppose we clamp the valve firmly in its position, as shown in Fig. 13, and with the eccentric rod as a radius swing the center of the eccentric across the shaft. We see that for this position of the valve—that is, for either admission or for cut-off—the center of the eccentric can only lie on the arc $x\,y$, but it must also, after the eccentric is keyed in position, fall on the circle $c\,d$, whose radius is the throw of the eccentric, and hence the center of the eccentric must be either at c or at d for this position of the valve. We see from the figure, 13, that the direction of motion of the valve will be opposite, depending on whether the center of the eccentric is at c or at d, and we find that when admission takes place with the eccentric at d, cut-off can take place only when the eccentric is at c.

After the eccentric is keyed to the shaft its center, in moving from c to d, turns through a semi-circumference or 180°, and as crank and eccentric are keyed to the same shaft, the crank must have moved through 180° in the same time. This brings the crank from B back to A, and the piston to the end of its stroke toward the left, all of which we find to be just as we assumed in drawing the theoretical card.

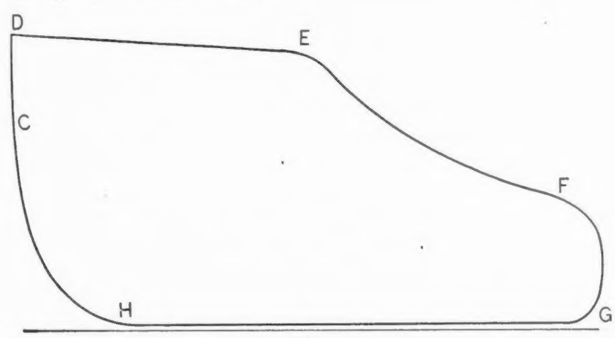


Fig. 14

The form of valve already designed is chiefly useful as a step toward understanding the action and design of a slide valve of the usual type. Even at the low rate (30 revs. per min.) which we assumed as the speed of the engine, we note two very grave defects. It is extremely wasteful of fuel, and the entire absence of compression would prove destructive to the bearings. First, the engine takes a cylinder full of steam, at full boiler pressure, for each stroke of the piston, and at the end of the stroke discharges it to the exhaust as hot as when it was admitted to the cylinder. Now if we could, in some way, arrange to admit steam during the first half of the stroke, and then cut off and allow the half-cylinder full of steam thus admitted to expand during the remainder of the stroke, the steam would be discharged to the exhaust at a lower pressure and temperature; that is, part of the heat in the steam which we now throw away would be converted into work.

Second, there is no provision for relieving the stress which the inertia of the reciprocating parts throws upon each bearing. Steam is admitted suddenly and follows the piston full stroke; at the end of the stroke it is as suddenly released and the steam pressure is instantly applied in the opposite direction. It is evident that under these conditions the steam and inertia forces combine to bring a heavy stress on each bearing just at the end of each stroke, a condition of affairs which would be indicated by a heavy "thump" if there was the slightest bit of "lost motion."

In the usual form of slide valve these faults are corrected. Steam is used expansively, and other changes are made which allow the engine to be run at almost any speed desired.

We will next design a valve of this form, and, as in the previous case, the first step will be to lay out a theoretical indicator card. Fig. 14 is a reproduction of a very good form of card for an engine cutting off at half stroke. The engine from which this card was taken was fitted with the Corliss type of valve gear, and while we must not expect, with a single valve and a single eccentric, to get as fine steam distribution as the Corliss people secure with, in this case, four valves and two eccentrics, still it makes a good ideal to which we will approximate as closely as we may.

We note that while cut-off, E, takes place at half stroke, and only half a cylinder full of steam is admitted for each stroke of the piston, the area of the card D E F G H C, which is proportional to the work done by the steam, is about ¾ as large as the rectangular card that we obtained when steam was admitted full stroke. This indicates the saving in steam by cutting off earlier in the stroke. At or near H the exhaust valve is made to close; no more steam can escape from the cylinder, and we note the gradual rise in the back pressure line, from H to C, as the imprisoned steam is compressed into a smaller space by the advancing piston. This gradually increasing pressure, acting during a considerable part of the stroke, acts as a cushion, a gradually increasing retarding force, tending to bring the heavy reciprocating parts easily to rest, and gradually reversing the direction of the pressure on the pins and bearings.

With these changes we have a mechanism, with large power in proportion to size and weight, that will operate smoothly and quietly with fair economy of steam, and one capable of being run at any reasonable speed. This we may fairly call an engine, and the next operation is to lay out a theoretical card for a 10 x 12 simple slide-valve engine. Boiler pressure 80 lbs. gauge. Revolutions per minute, 200; clearance, 10 per cent.

* * *

A FEW PRACTICAL SHOP HINTS.

J. T. G.

To do the most work in the least time and keep up the quality is the problem which those who have to do with machinery are continually trying to solve. The most successful shops are those which come the nearest to solving it, but perfection is something which the human mind is unable to attain, and occasionally the most expert managers can get some good ideas from their workmen.

Probably the best shops in the machine business are those whose managers realize that their workmen have some brains, and try to profit, by giving some inducement to use them. Numbers of shops have benefited by giving out work by the piece, and this leads to the vexed question of piece-work.

Let us suppose that a shop, which is somewhat behind in its equipment of useful tools and handy appliances, commences to give out work by the piece, the prices to be set by the time it previously took to do the work by the day. Pretty soon the workmen get so they can make good wages out of it, they study how to devise quicker ways of working, but usually are cautious about making an amount above what they think they would be allowed to, but finally they do exceed the limit and then comes the inevitable reduction in wages, with its consequent dissatisfaction on the part of the workmen. Piece-work is all right in theory and would be in practice if both sides were inclined to deal fairly with each other, but square dealing can hardly be expected while one side to a contract has the power to compel the other to accept its terms. For "the big fish will eat the little fish."

Another way to cheapen the cost of production, where the work will allow it, is to subdivide the work into different classes, such as lathe, planer, milling machine and bench work, and have each man to do but one kind of work; he then becomes so accustomed to that particular class as to greatly increase the amount of his work, many workmen are better satisfied working on one thing than they are changing around much.

It is said that in England if a workman applies for work and when asked what kind of work he is used to doing, should reply: "I can do anything." The foreman would probably say: "You are too clever, I want a man who can do one thing well." A workman may usually do some one thing, or kind of work, better than some other, but still the all around workman will always be in demand, he is useful for erecting machines, for tool work, or for overseeing the work of others, and his occupation requires more brain work and study than that of the man who can only do one thing or class of work, and he ought to be paid accordingly.

There are many shops that would get their work done much cheaper by obtaining some comparatively inexpensive tools and appliances. The old-fashioned grindstone, running badly out of true, is still in use, although there are emery grinders, with water pumps, that can be kept true much easier, and will grind tools much quicker and better. Twist drills are still ground by hand, while there are machines that will grind them with the right clearance and so they will cut a size which can be known by calipering the drill.

Some shops have no better way to get arbors in and out of the work than by heavy chunks of cast iron with a large hole in the center and a number of collars, which sometimes have to be looked

for in various parts of the shop; with these the workman builds a cob house, which he holds with one hand, while with the other he drives out the arbor. And there are arbor presses in the market with which an arbor can be put in and removed in a few seconds. Soft arbors are still used, and the shops using them are losing money on them the longer they are used, besides, the work done on these arbors is not likely to run true. Many shops are poorly supplied with bolts and nuts, clamps and straps, and in other cases there may be a good supply, but there is no definite place to keep them and there is many a hunt for these articles. Sometimes it takes longer to get them than it does to do the job. This frequently happens when the job is wanted in a hurry, and is quite exasperating. Sometimes when the bolts are obtained the bolt heads will not fit the machine slots and have to be reduced.

It would pay such shops to have a cupboard made with places for the bolts to be held by the head, and the size and length of the bolts put where it can be seen, and there should be a number of each length; better have too many than not enough. This cupboard should be in charge of some one who should be responsible for such bolts, clamps, etc., being kept in proper condition, and would see that they were returned to their proper places after being used.

The majority of shops probably still use a soft live center in lathes for convenience in truing up, while the tail center requires to be hard. When the tail center requires truing it has to be annealed, trued up and hardened again. Sometimes it springs out of line in hardening but, of course, the tail-stock can be set over to accommodate it.

There are excellent center grinding attachments, which will fit any lathe, which can be quickly put on and operated and will produce the correct 60° standard center angle at a comparatively small expense, and the work done on those centers will be of a better quality. Tapers are still turned in lathes by setting the tail-stock over, necessitating truing up the centers after each job, besides producing imperfect work. And yet there are excellent taper attachments for lathes on the market.

Many shops center work with bench centers, a hammer and center punch, drill and countersink, while a small centering machine and combined drill and countersink will do the work better in a fraction of the time. Many shops do not use machine or shell reamers for lathe work, but use flat drills only, and considerable care has to be used in calipering and grinding them, so as to leave the right amount for the hand reamer. Unless the flat drills are turned in the lathe so they will not require redressing, which is quite expensive. To aid in grinding flat drills accurately, take a piece of iron about $\frac{3}{8}$ by 1 inch and bend one end at right angles and put in a center, then the surface of the iron being chalked, and the drill placed on the center, lines can be drawn by the outer corner of the lips till they are ground equal. But if machine or shell reamers are used, the drill can leave about $\frac{1}{16}$-inch of stock and the reamer can take out the rest and leave the hole true and straight.

There are, of course, many other things in a machine shop that need reforming, and it would take a larger book than I ever saw to describe all of them, and even in shops, which are considered first-class and in fact do good work, there is room for considerable improvement in shop equipment. The reason why many such things are tolerated in shops is because the time-book and cost account do not show how much is lost by out of date tools and appliances. Occasionally shops lose money because of their method of management. Perhaps they place too much responsibility on some one individual and he does not have time to keep track of the work as it is being done. I have worked in various shops, under different systems of management, and have noticed the working of them to some extent.

There are shops in which, if a workman should misunderstand instructions on his work, he might spoil quite a number of pieces before it would be noticed; other shops, if the work was going wrong it would be noticed in a short time. For a shop where many are employed it is necessary to have a number of assistant or working foremen for each different class of work, they would have the time and experience to suggest what tools and appliances are needed, and they would get the benefit of the workmen's experience also, provided the latter felt that they were being used right.

Under this system less mistakes would be made because of closer watching. I do not advocate a "boss for every man," or for a foreman to stand watching all the time, or to watch in such a way as to make a workman feel that he is not considered capable enough to be trusted; for a good man usually likes to feel that he can be trusted to do what is right without too close scrutiny.

* * *

PROBLEMS IN MIXING LIQUIDS.

John H. Cooper.

The following problem was submitted to me for solution: "I have water running through a pipe at 182° temperature and another stream of water running through another pipe at 74°: these two waters unite in a third pipe forming a mixture which I find has a temperature of 94°; what I would like to know is: The relative proportion of water at the temperatures named, which are necessary to make a 94° mixture, and I would like to have the rule for doing it."

In order to solve this problem I refer to and use Nystrom's formula, working out the examples is given in figures, so that readers may understand and do this, as well as do any other similar problem, for themselves.

Referring to and reproducing Nystrom's formula:

$$W = \frac{w\,(t' - t)}{T - t'}$$

in which

W = weight or volume of a substance at the temperature T.

w = weight or volume of a similar substance at the temperature t.

t' = the temperature of the mixture $W + w$.

Let us insert in this formula the elements given in the problem offered and then work it out in the usual way; but first of all, we find that we have two unknown quantities to deal with. We will therefore assume one, since it is the proportion we wish to know and then we are prepared to find the other by the formula.

Let us assume $W = 10$ gallons per minute, at a temperature $T = 182°$ and then find w, which equals the gallons per minute at a temperature $t = 74°$; we have the temperature t' of the mixture given $= 94°$, and then by inserting these quantities in the formula noted above, we will have:

$$10 = \frac{w(94-74)}{182-94} = \frac{w\,20}{88}$$

therefore

$$\frac{w\,20}{88} = 10$$

Now if we multiply both sides of this equation by 88 and then divide both sides by 20, we will get $w = 44$; that is, 10 gallons of water at 182°, when mixed with 44 gallons at 74°, will make a mixture of 54 gallons and have a resulting temperature of 94°.

We have, further on, carried the same quantities and notation through complementary examples, which not only proves them to be correct, but clearly shows the way of working them.

Suppose we have a case of which we wish to know what the resulting temperature t' will be, by mixing 44 gallons at 74° with 10 gallons at 182°. For this we have the formula:

$$t' = \frac{W\,T + w\,t}{W + w}$$

Inserting the given values we have:

$$t' = \frac{1\,820 + 3\,256}{54} = 94$$

that is, the resulting temperature will be 94°.

Again, suppose we wish to know the temperature T of 10 gallons, at a temperature of 74°, that will make a mixture having a temperature of 94°. For this we have the formula:

$$T = \frac{w\,(t' - t)}{W} + t'$$

Inserting known values we have:

$$T = \frac{44(94-74)}{10} + 94$$

Therefore, $T = 182°$.

Having now solved the problem proposed and having given the rule for working out such examples, to which we have added the complementary formulæ, let us turn to the elements upon which these formulæ are founded and then give a proof of their correctness.

First of all, the *unit of heat* is the quantity of heat required to

raise the temperature of one pound of water *one degree Fahr.* whatever be its initial temperature.

The law of mixtures may be clearly understood by reference to the following statement: If we mix one pound of water at 10° with one pound of water at 30°, the temperature of the mixture will be:

$$\frac{(1\times 10)+(1\times 30)}{2}=20^\circ$$

That is, there will be 40 heat units in the two pound mixture, or 20 heat units in each pound.

In order to prove the truth of Nystrom's formulæ, we offer the following array of figures, which are in accordance with the established rule for treating problems in which heat is concerned. These figures are the same as given in the question and first example:

$$\begin{array}{l} 10 \times 182^\circ = 1\,820 \text{ heat units.} \\ 44 \times \ \ 74^\circ = 3\,256 \quad \text{"} \quad \text{"} \\ \hline 54 \times \ \ 94^\circ = 5\,076 \quad \text{"} \quad \text{"} \end{array}$$

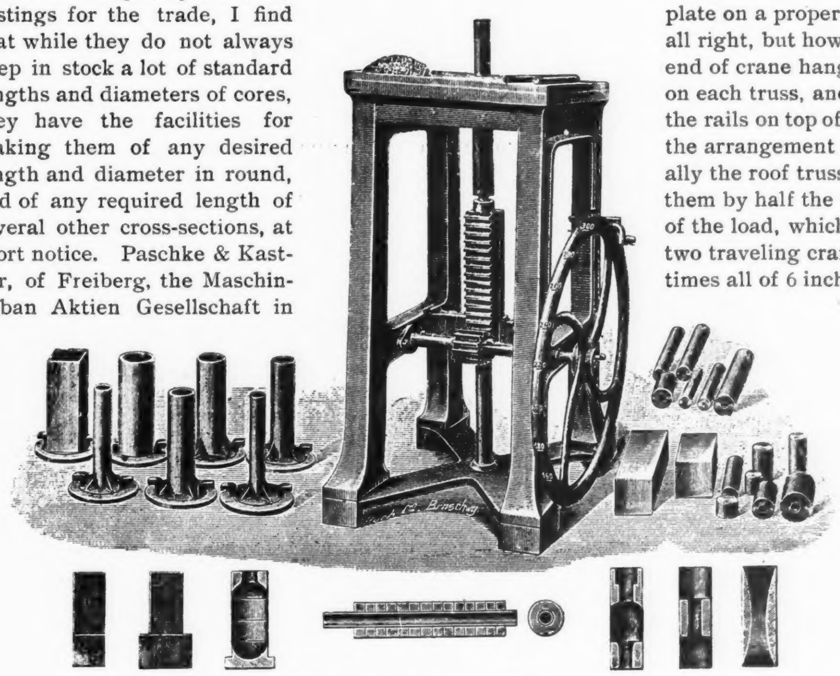
That is to say, the sum of the heat units in the mixture $=5\,076$, and when these are divided equally among 54 pounds or gallons of water $(W + w)$ at the initial temperatures named, there will be produced a temperature of the mixture $= 94^\circ$ Fahr.; supposing, of course, that no heat is lost in the transfer and diffusion.

* * *

CORE-MAKING MACHINERY.

Robert Grimshaw.

As a rule, the Germans do not stock up with standard cores, as well regulated American foundries do, and to this we may attribute in large part the delay in getting large castings from a German foundry. But in several establishments which are working up a trade in quickly-delivered castings for the trade, I find that while they do not always keep in stock a lot of standard lengths and diameters of cores, they have the facilities for making them of any desired length and diameter in round, and of any required length of several other cross-sections, at short notice. Paschke & Kastner, of Freiberg, the Maschinenban Aktien Gesellschaft in Nurnberg, Haubold of Chemnitz, and others, use a machine which does the work very nicely, and which is here shown. It is made by Bernhard Rober, Kaiserstrasse, Dresden. There is a strong table frame, to the under side of the top of which the core moulds (shown upside down to the left in the cut) are affixed by a bayonet joint. An arbor bears a pinion and a hand-wheel, by which to turn it. The pinion engages in a vertical rack, the upper end of which bears a plunger fitting the core-moulds. The hand-wheel has on its rim numbers indicating against a pointer the amounts of vertical motion given the rack and the plunger by each corresponding fraction of a rotation.



CORE-MAKING MACHINERY.

The mould being attached and the plunger inserted and brought down to the lowest point, sand is lightly tamped into the mould, from the table. Then the wheel is turned until it indicates that the right length of core has been shoved up; this is then sliced off and another piece of any desired length shoved out, and so on, until the entire contents of the mould have been used. When only one core is to be made, the plunger, acting as a false bottom to the mould, is run down until the scale on the wheel shows just what depth is given in the tube. Before using, the walls of the mould are lightly oiled; a lamp-chimney brush being generally used instead of a rag swab. Where the core would be too compact if made all of core-sand, a little ground coke is mixed with the latter.

The German foundries think it something remarkable that the use of this machine permits the delivery of cast pipe 250 mm. = 10 inches bore, with several branches, in ten hours from the time of reception of the order.

There are three sizes of the machine, the smallest making cylindrical cores up to 30 mm. = 1 foot long and 25 to 50 mm. = 1 to 2 inches diameter, the second the same length and up to 130 mm. = 5.2 inches diameter, and the third the same length and up to 300 mm. = 12 inches diameter. The weights are 215, 300 and 550 kilograms, or say 475, 665 and 1 225 pounds respectively.

* * *

FOUNDRY TRAVELING CRANES.

Theo. F. Scheffler, Jr.

For the best results in a foundry, there should be no columns between building walls. The traveling crane should occupy the entire span and not be supported by the roof in any way, which is a great mistake and is not safe for the workmen working below the crane. This of course necessitates a very large crane to do the same work that a smaller crane can do with one-half the span, but the greater span will be an object and will lessen the liability to accidents materially. The writer knows of a case where the workmen are in constant danger, especially when any very heavy casting is to be made. The traveling crane is supported on one side by the building wall, columns are bolted in place against the wall, and the end of column rests in a cast iron plate and the plate on a proper foundation. This part of the arrangement is all right, but how about the other end of the crane? The other end of crane hangs from the roof truss, hangers are placed one on each truss, and then I beams are bolted to the hangers and the rails on top of the beams, in the usual manner. The part of the arrangement that the writer finds fault with, is that originally the roof truss was not intended to carry the load placed upon them by half the weight of crane, rails and beams, to say nothing of the load, which amounts to considerable at times, as there are two traveling cranes running constantly. The roof will sag at times all of 6 inches when the cranes have a very heavy load to carry. The span of these cranes is about 35 feet, and to have a crane that would span the entire building would require one about 70 feet. But this span nowadays is nothing, and it would certainly pay the owners to have one placed in the foundry, so that the men could work with a greater degree of safety.

* * *

"REVERSE" BLUE PRINTS.

For shop use, the regulation blue print, with its blue back-ground and white lines, probablyserves the purpose better than any of the variations which are occasionally used, as it shows the dirt, due to handling, less than the white back-ground with either blue or black lines.

For office use, however, or for places where a "picture" effect is desired, the blue lines on a white ground are preferable, and would be used much more were it not for the trouble of making them by the usual process, which requires a specially coated paper and a chemical developing, both operations being similar to developing a dry plate.

There is a concern in Chicago, however, makeing a specialty of blue print, who have adopted an ingenious and simple plan for producing "blue line" or reverse prints. They first make a regular blue print from the tracing on a thin bond paper, and using this as their tracing or negative, take the blue prints from it in the ordinary way, producing, of course, reverse or blue *line* prints, which are clear and clean in every way.

* * *

Don't jump at conclusions after one trial of a new device; or if you do, don't tell anyone else until you have made another test.

STEAM ECONOMIES.

W. H. Booth.

It is always desirable to remember that everything which tends to economy is apt to be accompanied by something else which tends exactly in the opposite direction. It matters very little whether the economy is sought in mechanical, physical, chemical or commercial directions, the same general effects are observed. Let us take first a mechanical question. We will choose that of rope driving. It is self-evident that a speed of one foot per second is too slow. We all know that the power of a rope or of any other means of transmitting force varies directly as the speed. For a rope velocity of one foot per second we should use ten times the number of ropes that would be needed if the velocity were speeded up to ten feet per second. That would be a plain and obvious object lesson. Looking deeper below the surface we should begin to see that the more slowly running ropes were very much more durable, by reason of their small wear and tear than the others, and if the cost of removal was very great this would have weight in making us stick to the slow speeds. But it is very unlikely that the wear at the slow speed would be only a tenth of that at the higher speed. The ropes at ten feet velocity would last at least twenty years. My own opinion is that they would last much longer than twenty years. Would the slower ropes then last ten times twenty years? The idea is not to be entertained as a practical one, for nobody wishes to provide rope gearing longer than ten or a dozen years ahead, especially if the first cost of ropes is to be tenfold. However, having seen a tenfold economy in first cost by increasing speed tenfold, we decide to follow the same lines and reduce the ropes to only 1 per cent. of their original number and to run them at a speed of 100 feet per second. We shall be disappointed in the result. The ropes now fail rapidly, and we begin to find out that there has come into play another unsuspected action, and this we discover is centrifugal force, which we learn increases as the square of the velocity. At the first speed the centrifugal force was very little, nearly nothing. At ten feet per second it was still a mere trifle of the 600 pounds allowable working tension, but at 100 feet per second we should discover that we had actually passed the point where the gain of working capacity due to velocity increase was greater than the increase of centrifugal tension. Further investigation and study would show us that the best velocity is about 83 feet per second, or as it is taken in round numbers, 5 000 feet per minute. We are thus taught that while we have been very properly economizing by adding to speed, there has been a contrary action steadily encroaching on our economy until, had we been too dull to perceive it, we could have gone up to a speed of nearly a hundred miles per hour, at which velocity all the safe working load of the ropes would have been absorbed by the whirling stress and none would have been left for useful work. Having recognized these facts we are free to perceive and to utilize in our practice the fact that between 3 000 and 6 000 feet per minute, we can without departure from good practice design a rope gear on good and reasonable lines. At the higher speeds we have increased wear and tear; at the lower speeds we lose some of the fly-wheel steadying powers, but looking at all the facts we perceive that we need not go out of our way to increase a pulley diameter in order to get a rope velocity of 5 000 feet, nor need we reduce a desirable piston speed solely to get below 6 000 feet. It might happen that the use of a less speed than 6 000 would demand pulleys of too small a diameter, and that the bad effect of small pulley diameter would more than overbalance the benefit of a reduction of a thousand feet of velocity.

All engineering work is not new work, but much consists in adapting existing conditions, and when necessary I have not hesitated to advise the use of ropes at even less than 3 000 feet velocity, and have run them with the slack side below to the reduction of their arc of grip. Yet they have, where properly proportioned as to number, been quite a success, and served but as another of the instances, which experience affords us that there are no hard and fast lines in mechanical engineering. This is what really makes of mechanics a liberal art, for were we absolutely tied to a definite speed for ropes, there would be nothing to do but to design everything to fit this speed. There would be no opportunity for the exercise of judgment in securing the best out of a thousand different ways of solving the problem. Design is really the securing of a working compromise of many antagonistic factors. Exactly similar conditions are met with in steam engineering. Ask a boy who has recently acquired his first knowledge of the benefits of steam expansion to sketch out a good indicator card, and ten to one he will choose a ratio of expansion which is far higher than he would choose ten years hence, after he has learned by experience how the effects of engine friction, radiation losses, first cost and cylinder condensation put a stop to the benefits of expansion at a very moderate ratio indeed. The latter source of loss especially advances very rapidly to overtake the decreasing economy due to increase of expansion, and so on we might go to any extent with parallel instances. It is, however, not alone in things mechanical that the causes arise which stop the march of an economy. There are other factors. High pressure steam is theoretically an economy, but to secure the economy demands a high pressure condition of attention, and many other expensive conditions. Electric lighting has been responsible for showing up many things less understood, because less frequently encountered in practice before the days of the variable and light loads common in electric service. When in full work an electrical station may well work at top pressure, but it is questionable wisdom, and has been proved so in practice, to run the light daylight loads at full boiler pressure. The demand for steam is small and yet the loss by radiation from the boiler and steam pipes continues unabated and forms a very much heavier per centage of the total steam used than when the boiler is at full work. Wear and tear is less at a lower pressure, and the water in the boiler being at a less temperature, is better able to absorb the heat of the furnace gases than when full pressure is on, and everything points to the economy and comfort of lower pressure for light loads. It is only by rigid care and attention to leakages that high pressure steam can be made to yield the economy or any part of it that theory would point to as proper that it should yield. And such economies as are secured with high steam pressures are as often secured as the result of perhaps less radiation losses in the small first cylinder and the reduction of leakages at the piston, not reduction of actual leakage at each inch of piston circumference or the trapping of the leakage from one piston by the next cylinder.

Engine attendants are sometimes apt to cry over the old-fashioned type of machinery they have got to attend, as though they felt it to be impossible to secure good results from anything not of yesterday. But they are wrong in this. I have seen better results got out of old engines, old boilers and old conditions generally than have been obtained with all new work, and it has been done simply by care and attention. In the first place there was allowed no want of safety valve tightness, and firing was managed in a way that did not keep the safety valves always on the puff, a habit that is far more wasteful than is sometimes realized. Again, there was no bareness of steam pipes; the flanges as well as the bodies were protected, and above all, the vacuum in the condenser was taken care of most thoroughly.

Injecting pipes are porous, and, if long, let in a lot of air. Paint them. Look after all possible air inlets and don't rest satisfied so long as the vacuum gauge shows a substantial reduction after an hour's stoppage. What has been done can be done, and old engines have been brought to a state of tightness sufficient to show 12 pounds vacuum after a stoppage of an hour.

It is all very well to call out for things new and modern, but before getting them be very certain that they are better than the old. An old engine is not necessarily wasteful. Age presupposes worn-out valves and scored cylinders and rods, but it does not always have these accompaniments, and there is really nothing in an old cylinder that marks it as being necessarily wasteful. Especially do these remarks apply to small places where the magnitude of the power plant will not afford the outlay necessary for care and for prompt repairs so needful with high pressure. Any delay with high pressure means rapid wastes until repairs are effected, and this is a serious set back for high pressure.

In marine work the economy of the high pressure system with triple cylinders is very great. It is doubly an economy because what is saved in weight in machinery becomes available for paying cargo. But it is just this paying cargo that enforces the obligation of keeping things up to the mark or running short of coal, and no expense is spared to keep up to the high-water mark of efficiency. In stationary engines, unless rent comes to a heavy item per square foot, as in London or New York, there is not the equivalent of the paying cargo, and less efficient types can be made to show better results commercially. There is

no excuse for carelessness in attention to the old plant. No man of sense uses an old plant if he can afford new and more economical one. A new plant is not always within the power of a man to purchase, but the best way to enable him to do so is to save all the coal possible with the old machinery and for a man to thereby prove his capacity to take care of the new when it can be afforded. In steam engine economy it is often easy to cut down fuel by a fourth or third. These big reductions can be made very quickly, much more quickly than the next cut of a tenth of the amount. These are only secured by careful attention to what appear minutiæ, to care of the small losses at guage cocks, the bare pipe flanges, leaky valves and so on, but these all repay the attention bestowed on them.

* * *

A RUBBER SHOE AND HOW IT IS MADE.

WARREN E. WILLIS.

As the majority of people will soon avail themselves of the protection afforded their pedal extremities by means of rubber shoes, some idea of their manufacture may, perhaps, be of interest.

Gum caoutchouc, or India rubber, is that sap or fluid which exudes from a tree growing in tropical climates, having a straight, smooth stem, with large, thick, somewhat glossy leaves, called, botanically, *Hevea Guinensis*, indiginous on this hemisphere, in Honduras and Central America principally.

Charles Goodyear was one of the best-known pioneers in the India-rubber business, taking out his first patent in 1836. Four years later he took out a patent for the sulphuring process, but the sulphur imparted an offensive odor and did not prevent the rubber from hardening in cold weather. By devoting much time to experiments he found that the application of considerable heat would cause the sulphured article to be pliable in cold weather, and also that it increased its elasticity in all temperatures. The result was his patent in 1844, which was re-issued in 1849, extended in 1858 and again re-issued in 1860.

The method in vogue among the natives for obtaining this sap is by tapping the tree, in a manner similar to that of our maple-sugar producers, only by ruder methods; the incision is not so deep, and, in addition, a series of rings or annular groves (on the barber-pole plan) are continued upward and around the trunk to a considerable height. A naked native, suspended by a stout raw-hide strap, encircling both the tree and the person in such a way that, by bracing his feet against the trunk, his weight is sustained and his hands left free to assist in swinging around, ascending and descending, as well as to use the "matchette," or large knife, with which he is provided to chop away the bark, allowing the sap to flow down the rings and collect in a vessel below the lowest cut at the bottom of the tree. Possibly the tree will survive one such operation, but seldom two, as, besides the mutilation of the bark and extraction of its life blood, swarms of small insects enter the cuts and complete its destruction. From one to four gallons of a viscid, cream-colored fluid are obtained from each tree tapped.

The contents of each vessel being poured into a large pan or vat, is there intimately mixed with the bruised stems of a wild vine called "mesquito withe," which has a similar effect on the sap as sulphur in thickening or coagulating it. When of sufficient consistency it is taken from the pans and allowed to become partially baked by the sun, in which condition it is brought to the place of shipment, where it is worth from 35 to 50 cents per pound.

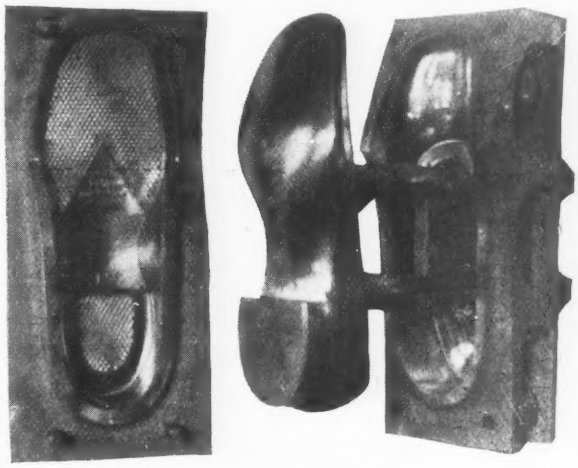
The rubber is usually received in large cheese-shaped cakes, which, before going into the washing machine or cracker, are cut by circular knives into sizes suitable for the machine. It passes a number of times through these washers, becoming thoroughly disintegrated and ground to a pulp, water and steam being liberally sprayed on it during the whole process.

In this pulpy condition it is mixed with the various substances it is desired to incorporate, chief among which are lampblack, whiting, litharge, tar and sulphur, in varying proportions, according to the purpose for which the rubber is intended, that for shoes being frequently as low as 10 per cent. pure gum, while the best is not over one-third rubber.

After further rolling through the corrugated rollers, driven by very powerful machinery, it is passed through finishing calenders, issuing in a smooth sheet of uniform appearance and of a desired thickness for the different parts of the shoe.

In most factories it is again passed through engraved rollers, having on them the impressions of the various parts, as soles, heels, vamps or uppers, which serve as a guide to cut them by, and also puts on the crossed appearance of the bottoms of the soles, the factory stamp and other embossing desired.

In the factories it is the practice to cut the various parts from material of the proper thickness by dies (similar to those used for leather goods), and unite the various parts by cement, piping being used to cover the joints. They are then packed, so as to be just clear of one another, in an iron box provided with wheels, which is run into the vulcanizing ovens, where they remain in a temperature of 170 degrees for a period of six or seven hours.

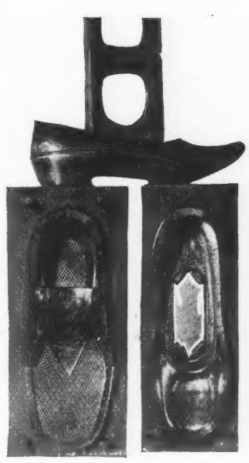


RUBBER SHOE MOULD.

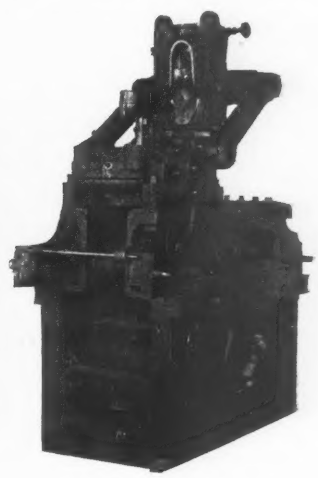
After removal they are washed in a strong alkaline solution, to remove any traces of sulphur, etc., that may have worked to the outside, and given a coat of varnish to produce a smooth, glossy surface.

The process of manufacture varies in each factory in many particulars, but the general mode of procedure is substantially as given. Moulded rubbers are probably the best made, not only on account of the stock used, but that more attention has been paid to the details of construction. For instance, a slight depression or groove runs around the entire inner edge, preventing the heel or sole from cutting the corners.

Careful differentations are also made in the thickness of mate



MOULD.



PRESS OPEN.

rial over the entire shoe, serving to make it light, without decreasing strength, and, further, the shoe being made in one piece, there is no cement joint to become loose.

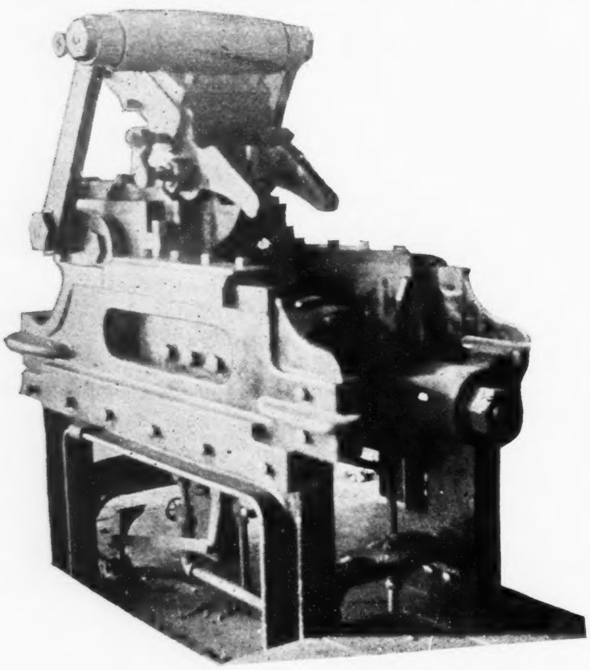
In this make of rubbers material of the proper thickness and mixture is placed in metal moulds consisting of three principal parts, viz., sole, last and upper, or, in mechanical parlance, a two-part flask of nowel or drag, core and cope, illustrations of which are given. A press is also shown, arranged to hold these moulds, and subject them, along with the enclosed material, to about 327 degrees of heat, and, at the same time, to a hydraulic pressure of about two tons per square inch. These presses are capable of turning out, on an average, about six pairs per hour, one man attending to four presses.

The moulds for the formation of rubber are somewhat similar

to those used for certain articles of glass, as regards their construction, and yet different, as will be shown. In a factory where but one line of goods is manufactured, as shoes, which embody several distinct styles, each varying from eight to twelve sizes, with a right and left of each—say, averaging three styles with ten sizes—sixty moulds would be required. These moulds must match very closely in their different parts, and also in relation to the last, which forms the core contained in them. They must be perfectly smooth, of sufficient strength to withstand a pressure of 4 000 pounds per square inch, must have a definite graduation as to size, but no variation in shape from their special style, except that in the larger sizes the thickness of the material is increased at certain points on the shoe.

Unlike most mechanical operations, there can be no way of proving or determining the proper progress as regards contour; as from its shape, changing as it does at every point, no definite measurements can be taken until complete and a cast made from it.

From the shoe as moulded measurements are taken with broad pointed calipers, as to the thickness of the material in different places, and these measurements must agree with predetermined dimensions within a close tolerance. Herein lies the difference between glass and rubber mould making, for in the former templates and gauges can be made for most goods, and again, their



PRESS CLOSED.

shape is usually such that the moulds can be machined more or less closely to shape, but for the latter hand work must necessarily be employed and a bewildering array of peculiarily shaped files and chisels are necessary adjuncts. In fact, the only machine work that can be done is the exterior, if we except small emery wheels driven by flexible shafts and used to a limited extent on finishing the surface.

It may be argued that templates could be made for the work, and in expectation of something of this kind I will explain that, barring accidents, a mould will last as long as that particular fashion of rubber lasts, so that each would require its full complement of guages which would be used but once, and the time taken in the making would go a long way towards completing the mould by an expert workman; indeed, he would not be willing to believe any system of guages whatever could produce so symetrical a shape and regard the innovations as an insult to his intelligence and ability, and it is believed that the readers will, upon consideration, agree that his experienced eye affords him a surer guide at less expense than has yet been devised.

* * *

The Waterbury Farrel Foundry & Machine Company, Waterbury, Conn. have recently fitted out several complete tube plants, three of which were hydraulic and one a chain draw bench. They have also had quite a run lately on forging drops for bicycle manufacturers, having supplied thirty for one plant alone.

NOTES FROM NOTOWN.—16.

BORING CYLINDERS—STARTING RIGHT—ORDERING TOOLS AND ENGINES—ECONOMICAL HUMANITY—STEALING DESIGNS.

Ichabod Podunk.

Most of the boys enjoyed the letter from R. E. Marks about boring cylinders without stopping, especially those who have worked in railroad shops where this seemed to be epidemic. The *position* of cylinders to be bored, however, is causing a little stir; some of the boys claim they should be bored in a vertical position, and trot out lots of alleged authorities on shop practice who agree with them. Personally I don't, and as we bore a good many cylinders, I asked Mr. B. what he thought of it. "I've always held," said he, "that a large cylinder should be bored in the position in which it is to be placed in actual use. A large cylinder, if placed horizontally, will sag out of round from its weight, the top will drop a little, and it will not stay round even if it is so to begin with. Now if we bore a big cylinder in a vertical position and then turn it over into a horizontal one, it will deflect just the same and not be any nearer round than if bored the other way. In fact I believe you can get a horizontal cylinder nearer round by boring it in its normal position, as the boring tools, if kept sharp and well supported by a stiff bar, will tend to cut out some of the deflection, if this term can be used. If large vertical cylinders are bored in a horizontal position and then placed vertically, they are almost sure to change shape. In fact all steam cylinders are apt to change shape somewhat after they are heated with the steam, as the difference in the mass of metal at the different parts of the cylinder causes it to change shape. One English builder of Corliss engines goes so far as to put steam in the jackets of his cylinders during boring, so they will assume the same shape as when working under steam." Mr. B.'s ideas regarding the position of cylinders during boring seem very sensible to me, probably because I have been thinking the same way myself for some time.

We are fitting out a new concern for making a certain style of small engine, nothing revolutionary, I guess, but just a good, simple engine that will run without much looking after. They have ordered several machines of us, and the other day when the manager was in here, Mr. B. had quite a chat with him about the tools and other plans. Among other things, Mr. B. said: "Now, Mr. X., I don't want you to think I'm gunning for more work, but it occurred to me the other day that you might not have ordered any tools for these machines, and when you get them all set up in your new shop you might not be able to get to work till you made some tools; this would be both annoying and expensive, as you don't want to wait a minute before getting to work. You can have the tools made where you please, though of course we would like to make them for you; but if you take my advice you'll have enough tools made for all your machines to start with, even if you devise and make others after you get started." Mr. X. agreed with him, thanked him and ordered him to make such tools as he considered necessary for the work he had to do. Yon don't often see orders given in this style now-a-days—usually want every tool specified and the cost down to the last cent. Of course its business to look after such things very closely, but Mr. X. didn't lose anything by trusting to Mr. B.'s judgment and honesty, and it might not do any harm if more business was done on this plan when you know who you are dealing with. About the biggest off-hand contract I know of was given a few years ago to a well-known engine builder. A large mill owner came into the office, said "Well, Charlie, we are building a new mill and want a new engine. It's about the same size mill as the other and I guess it will need about the same size engine, but you better come down and look it over, then you'll know what we'll need. We want it in about three months, Charlie. Good bye, now, I'm in a hurry," and he was off. The engine was ordered and not a word about the price. He knew "Charlie" well enough to know he would get a good engine at a fair price, and he did. And it's running yet, by the way.

Mr. B. had another caller last week, a builder of machine tools who is well known; and, as is his custom, he sat near my end of the shop while talking to him, so that I couldn't help hearing most of the conversation. But as Mr. B. knows it, I guess no law of ethics or etiquette is warped very badly.

"Times are bad enough, Mr. B., but what galls me more than that is, after working for months on the design of a new machine, to have some other builder go to a customer of ours, get his permission and then deliberately measure every part, and first thing we know, some other builder comes out with a "new" machine, exactly like ours, and under sells us to our former customers, the one who obliged him in the matter of getting dimensions among the rest. Talk about the Chinese and Japs only buying one machine and then copying it, some of the men here haven't even the grace to buy *one*. Why they even copy my electrotypes, or use the same one. I suppose it will come out all right some day, but it's mighty tough while it lasts, Mr. B. It's a matter of education, I suppose, Mr. B., and that's slow work. By education I mean that buyers must be educated up to realizing that both financially and morally, it pays to buy of the original builder, who knows enough to put in good work on the machines to preserve his reputation."

It's quite a problem at best, and I don't know as I blame the machine builder for kicking; think I would myself.

It pays to be half way decent with the employees of any place, not alone in the feeling it gives of wanting to shake hands with yourself and say, "Brown, old boy, you've done one good thing in your life, anyhow," but in plain dollars and cents; they seem to appeal to most men quicker than anything else. If you went to old John Blinker, who runs the conglomeration shop here in town (that's what the boys call it, because he does about everything you can think of—founding, buffing and polishing, nickel plating and makes sausage machines), and talked on the beauties of humanitarianism till you were blind, he never would have put in those ventilating fans or had the old shanty whitewashed from top to bottom. The agent of the Blow Hard Fan Co. knew old John by reputation, and he sized the place up before he tackled him. Then he showed him how he could save money by putting in a good system of ventilation, how the men could do more work and not feel it if he made the place cooler and freer from dust, and the saving in gas from white walls came easy after that. But it's a fact, and any firm can save money by following suit. Next he showed him how he could get more work out if he put in an exhaust fan to draw all the buffing dust and dirt out of the buffing-room, keeping the operators decently comfortable and making life less of a burden for them; it was the dollar that counted here, too.

When a man is covered with a combination of sweat, brass-dust and lint from a rag wheel, he isn't in the happiest frame of mind, to say nothing of his looking as though he had been called on by Whitecaps and given a coating of turkey hide. And a man who is thus adorned can't or won't work as well as the one who is kept decently clean and comfortable by having the dust hustled away from the wheel by an exhaust fan; they're great institutions for any shop having buffing or other dusty work. This isn't the only department that can be improved, both for comfort and economy, by the introduction of a few common sense devices. A few ventilating fans will add to the comfort of any shop at slight expense, and even the addition of palm-leaf fans to a line shaft are better than nothing; they keep the air moving, which is the main thing in ventilation.

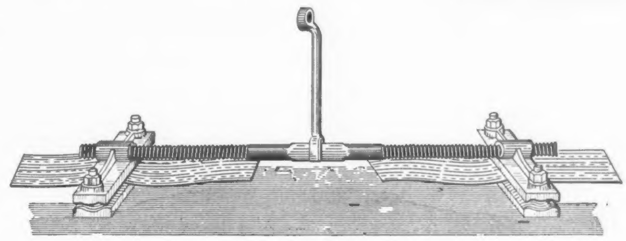
* * *

BELT STRETCHER.

One of the most troublesome things about a manufacturing establishment employing flat leather driving belts without an idler to take up the slack, is the necessity of having to cut out a piece every now and then, and re-lace or otherwise join the belt. If the manufacturer does this for the belt user, before the belt is put in use, the life of the belt is considerably lessened, so "extra stretched" belts should be avoided, where economy is considered of more consequence than trouble.

Furthermore, there are very few who can lace a belt so that both edges have equal tension. Where clamps are used, with one screw at each side, the workman feels the desirability of an extra pair of hands, and also finds it an annoyance to keep count of the number of turns that he gives each screw. If, however, he does not keep this count, the belt is liable to run off on one side of the pulley, by reason of unequal edge tension.

The rig here shown is for belts up to six or even eight inches wide, much more convenient than one with two screws, and it puts the tension on both edges alike if the right and left hand screw comes along the line of the center of width of the belt. The corrugations running lengthwise of the clamps give them an advantage over flat clamps which anyone will appreciate who has



BELT STRETCHER.

ever tried to take an eel off a fish-hook while holding by any other means than under his middle finger and over the fingers on each side.

This rig is unpatented, as far as I know, and also, as far as I know, unpatentable. It is in common use in Saxony. R. G.

* * *

HOW SHALL THE KEY FIT—OLD TIME DRIVING WHEEL FITS.

F. G.

One has only to follow what he reads about the way a key should fit to satisfy himself that his own practice is the best in the world, or the most miserable failure possible, just as he looks at it. A good deal of the difference in opinion on the subject comes, perhaps, from not considering, more carefully, what the key has to do before deciding upon the proper way to fit it.

Take, for instance, a key that has to hold a piece in position, against a strong endwise tendency, the piece being a slack fit. It looks rather reasonable to suppose—and it is reasonable—that the key should fit top and bottom. It is essential to oppose a good deal of friction to this endwise tendency. It is too bad that wheels have to be held in this way, but it is the truth that a good many do; still, as this is rather generally in the instance of light work, it is not of so much consequence.

In the instance of a large number of gear wheels of fine pitch, but some of them of considerable diameter, for which shafts were cut from long lengths turned as shafting is usually turned, the gears—many of them—run out sidewise so badly that the well finished rim looked the reverse of nice. To remedy this, the holes in the next lot were chambered and the key fitted in hub, at top, scarcely beyond the chambered part of hub, as exaggerated in Fig. 1. There were a good many wheels in the lot, and the plan was an improvement every way. The wheels run true sideways, and less rather than more, trouble to fit the key. The chambers, in this case at least, were not so long as to make it probable, if possible, that they brought about any springing of shaft, and the fit at the top was long enough for all practical purposes.

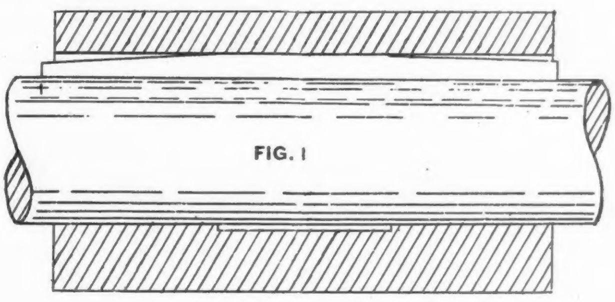


FIG. 1

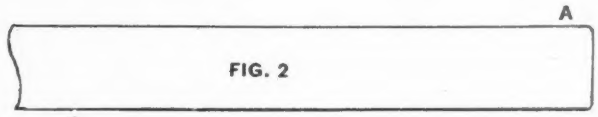


FIG. 2

Again most of us have seen keys fitted so hard, top and bottom, when the necessity for it was not evident, that heavy hubs, very snug fits, were thrown sensibly clear of the shaft. This is noticeable more particularly where two keys are employed.

When the hub is a tight press or screw fit to the shaft, it seems

to me more than a mistake to further strain it with as effective a wedge as a key makes.

I once worked in a small railroad repair shop in which hydraulic presses were yet to come. About that time the road was buying a few new engines of larger size than anything they had. Trouble came from the wheels getting loose. The foreman, an excellent mechanic, adopted the following plan for fitting all driving wheels: The wheels were bored $\frac{1}{64}$ inch taper in 7 inches length. Just why it was $\frac{1}{64}$ inch in 7 inches I never knew except that that was the length of the hub. In fitting the axles they were smoothly turned so that their weight would force them into the wheels $2\frac{1}{2}$ inches, then the wheels were drawn on with screws. The keys were of steel, planed so as to be just slack top and bottom. The front end of key was very slightly "rocked off" on the sides, as exaggerated in Fig. 2, and the end tempered. In driving this key it would just smooth the sides of the keyseat and fit tightly at *a*. I never knew or heard of a wheel fitted this way coming loose, and always doubted if they would have worked loose if there had been no keys. Railroad men will not fit keys that way now, which is not saying that it is not a good way, or that it may not be good for other purposes.

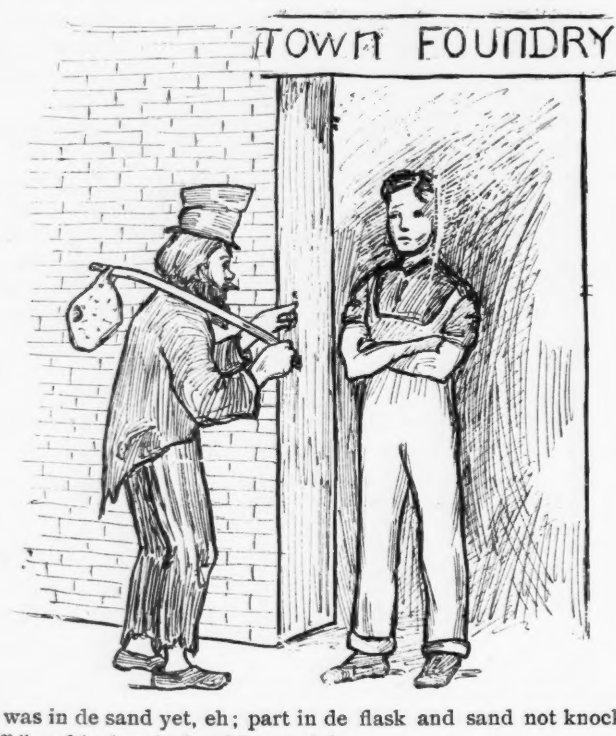
* * *

A TRAMP MOULDER.

R. E. Marks.

The other day as I was standing at the door of the foundry that I try to run somewhere between the walls of prosperity and bannruptcy, one of the hoboe tribé, who hadn't been on speaking terms with either soap or water for several years, sidled up to where I stood. I expected to be "touched" for a dime, to "save a starving man from dying of thirst," and so was unprepared for him, when he said: "Say, Kernel, can I look around de foundry wid yer, a little. Haint been in one fer ten years, but ez none uv de boys is 'round, I d like ter; de boys might think I wanted ter work. See!

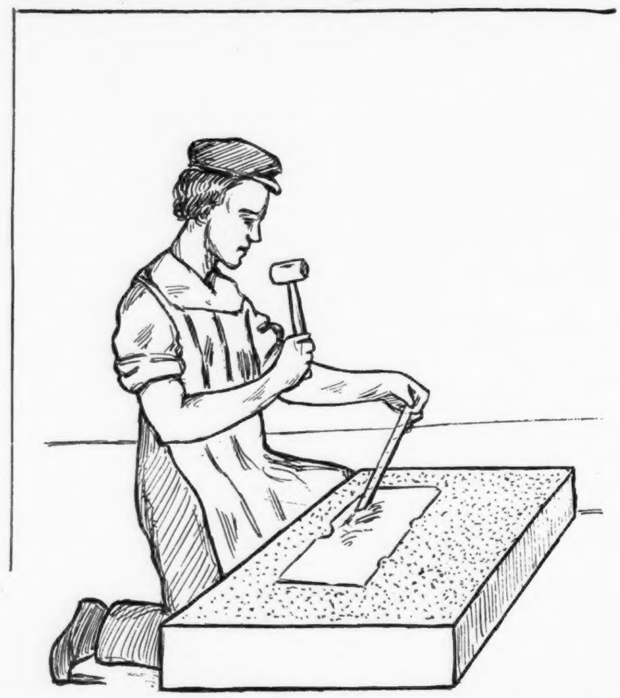
"Yer see," he continued, "I used ter be er moulder; looks so



I was in de sand yet, eh; part in de flask and sand not knocked off," and he laughed at his own joke.

Well, more to see what he had to say than anything else, I started to show him around, and some of his remarks, though crude and coarse, hit closer home to our foundry and lots of others, than I cared to admit to him.

"Same old thing," he remarked, as he saw a molder jam a pick into a new pattern, preparatory to lifting it out of the mould, "same old thing; jam a new pattern full uv holes wid de pick bang de pick wid a mallet, chew a big hole in de pattern and den laf when de man dat owns de pattern swears an' calls yer careless." This proved he had been in a foundry before. Then we found a man who happened to have a pattern with rapping plates, and who, for a wonder, was using them. "Dat's de stuff, Kernel; why don't all de pattern-makers use 'em? Never had dem when I was in der foundry, but dey's de stuff, sure, an' I'd have 'em on all my patterns if I was in de business." The next man was slicking up a mould which had broken a little, while near him was a moulder looking rather disconsolate over a



poor casting. "Same old thing," broke in the tramp, "stick a pattern in de mould more for looks dan anything else, haul it out and smash off a few corners, patch 'em up wid a gob of sand here and ram a nail into it to hold it or else kinder glue it on wid core wash. Den de man wonders what ails de casting and why it ain't like de pattern. Like ez not it comes out er de sand all blows, or de metal didn't run inter de corners, 'cause it got cold,

and de man was in er hurry ter get home, and wouldn't get more iron. I'se been dere, Kernel; see!"

Then, growing reminiscent, he said: "Moldin's a whole heap like er lottery, er playin' crap, Kernel; yer work away in the sand, pull out yer chunk er wood, put in yer core (wrong side up, probably), pour yer iron, and den wonder ef it's goin' to be good. Ef yer in a hurry, it's bad; den de molders get a cussin'. An' say, Kernel, don't yer think dat boys would stay wid yer better

and make better molders ef yer made things a little easier for 'em? It's no fun huslin' ashes, picking over scrap, tendin' de rumbler, brushin' castings and getting so dog-goned tired and dirty yer don't care whether yer ever wash up er not. Boys wid ambition like to get ahead a little, Kernel, an' I think, even if I am nothin' but a hoboe from Hackensack, dat yer can make better molders, better men and keep em wid yer, ef yer try ter make things es ezy fer 'em as the masheen shop duz, an' dat don't mean cushion chairs or kid gloves, either."

As Weary Waggles wandered away, without asking a man for a cent, I wondered if there wasn't more truth than poetry in some of his remarks.

* * *

Industries and Iron, London, issued a large special number on November 13th, which contained a history of self-propelling carriages and their present development.

* * *

SMALL UNIVERSAL GRINDER.

While the tool shown herewith is similar in many respects to the larger grinding machines built by Landis Bros., Waynesboro, Pa., it is their latest product and is known as the No. 1 Universal Grinding Machine. It is especially adapted for manufacturers of light tools and bicycles, the larger machines not being necessary for this work. For use in the tool room of small shops, where the work is confined to comparatively small sizes, and for grinding cutters, reamers, etc., it will be found particularly convenient. These machines are carefully designed to allow a free use of water in grinding, an advantage all will appreciate, as it prevents drawing the temper or the springing of work from heating.

One of the main features of the Landis machine is that the wheel travels along the work, instead of the work traveling past the wheel, a system which is highly approved by many. Lack of space forbids calling attention to the many novel features of the machine, but these are clearly shown in the treatise which this company publishes on the construction and use of grinding machines. This also contains much valuable information on grinding of cylindrical, conical and plane surfaces, and is a desirable addition to any library of reference.

* * *

Mr. Charles H. Besly, of Chicago, recently remarked to the writer, "I am quite familiar with all the principal mechanical papers that have been published since I first went into business; and not one of them ever approached the position and influence which Machinery has already attained."

ITEMS OF MECHANICAL INTEREST.

LARGE ROLLING MILL ENGINE.

A 10 000 HP. engine for rolling-mill work has just been completed by Mackintosh, Hemphill & Co., of Pittsburg, Pa. This is a particularly severe service, especially when directly coupled to the rolls as in this case, and the parts are exceptionally heavy. It is a pair of simple engines, with cylinders 50 x 72 inches, and piston valves.

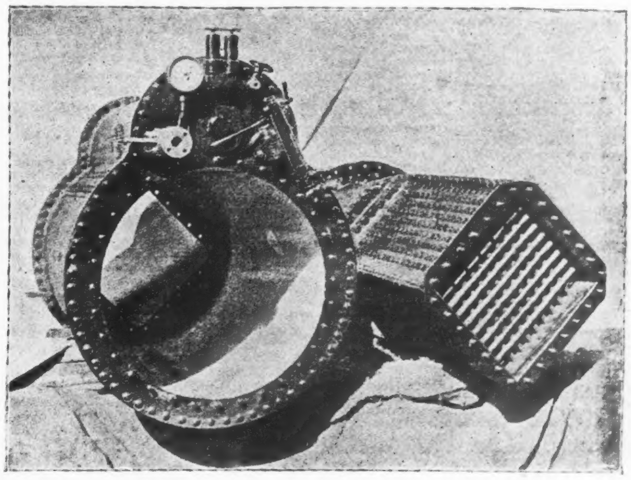
The shaft and main crank-pin are a single piece of forged steel and weigh 24 tons. The main or left crank-pin is 23 inches in diameter by 17 inches long, the other cylinder has an overhung disc crank. The whole engine weighs 800 000 pounds. It is a simple engine, instead of compound, as is usual for this size engine, but not for this work.

Another somewhat similar instance is that of the three new engines being built by the American Wheelock Engine Co. (Philadelphia shops) for the Chicago City Railway. These are built in pairs and are simple non-condensing engines, with cylinders 36 x 72 inches.

The chief engineer claims the simple engines are more economical for this work, all things considered, than compound engines would be, an opinion we do not agree with.

JONES'S WATER-TUBE BOILER.

The illustration shows a form of water-tube boiler invented by Mr. A. E. Jones, the works manager of Messrs. Whitehead & Co., of Fiume, and used by them for the last three years in one of their steam launches. It has been worked hard, with forced draught, without the necessity having arisen to touch a single tube. It will be seen that the boiler consists of a horizontal shell, with an interior furnace. The part of the furnace at which the bars are situated is cylindrical, the remainder being square in



cross-section, and accommodating two sets of tubes, each set making an angle of 45 degrees with the horizontal.

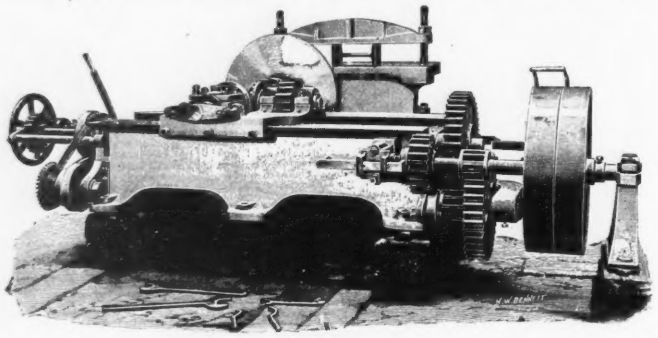
The interstices between the tubes go straight through from one end of the flue to the other, so that the tubes are as easily cleaned as those of a locomotive boiler. The swell on the upper part of the outside shell forms the steam space, the "waist" being held together by a perforated stayplate forming a chord to the large and small circles. The whole of the flue can be easily withdrawn from the shell for scaling.

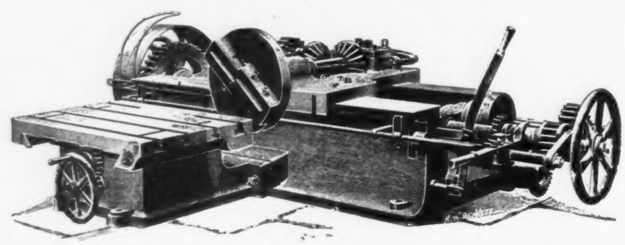
[Mr. James Watt Boulton, of Dee Lock, Chester, England, claims to have built boilers of this type as long ago as 1871, some of which are at work to-day.]

COMBINED COLD SAWING AND FACING MACHINE.

The tool shown herewith has recently been introduced by Messrs. Isaac Hill and Son, of the St. George Engineering Works, Wood's-lane, Derby, and is intended more especially for use in construction iron and steel works. The peculiarity of the machine consists in the fact that it may be used at will as either a cold saw or a facing machine. The upper view shows it arranged for cold sawing. The feed is variable and self-acting at all points, while the saw spindle is driven by steel gearing instead of the usual worm and wormwheel, thus greatly reducing the frictional losses. This arrangement of driving the saw spindle lends itself to a ready means for altering the speed used in sawing to a much quicker and correct speed for ending up bars. It will be noticed that the driving is effected by a belt and compound spur gear,

one train of gear (wheel and pinion) being dropped out of gear and a spare wheel substituted when speeding up is necessary. The work table is so arranged that for facing or ending up it is six inches below the centre of the spindle, while for cross-cutting work (in sawing) the table is raised by a making-up piece to bring it up to the proper height. When facing is required, the

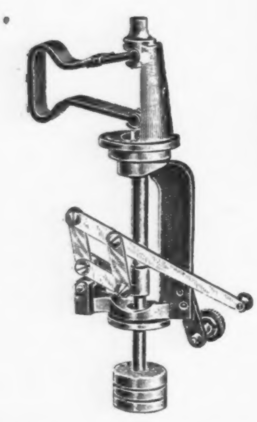


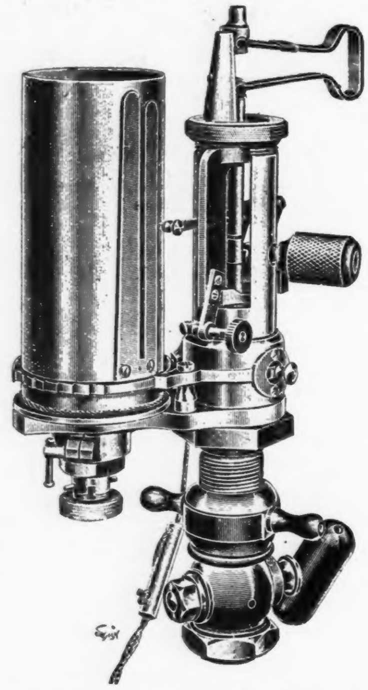


saw is removed from the spindle, and the facing head is attached as represented in the lower view. The belt pulleys measure 29 inches by 5½ inch face, and the machine is intended to saw sections up to 28 inches by 8 inches, while the facer head is 16 inches in diameter.—*Engineering*, London.

THE SIMPLEX INDICATOR.

The accompanying illustrations show a form of indicator which is being manufactured by Messrs. Elliott Bros., of 101 St. Martin's Lane, London, W. C., and designed for use with either steam, gas, or petroleum engines. Instead of the ordinary coiled spring, one of sugar-tong form is used, situated at the top of the instrument, as shown. It is claimed on behalf of this arrangement that the spring can be more easily changed, and that being

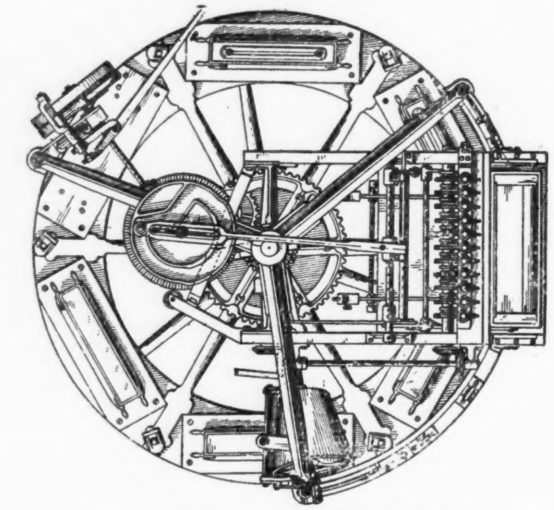


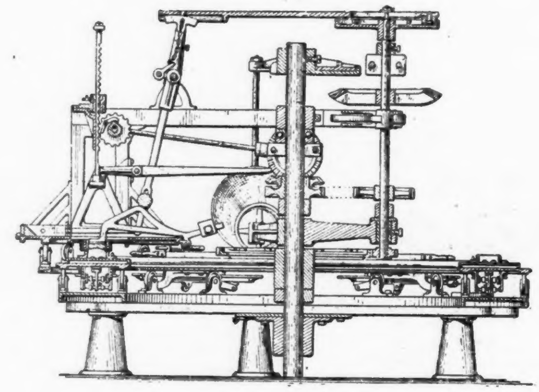


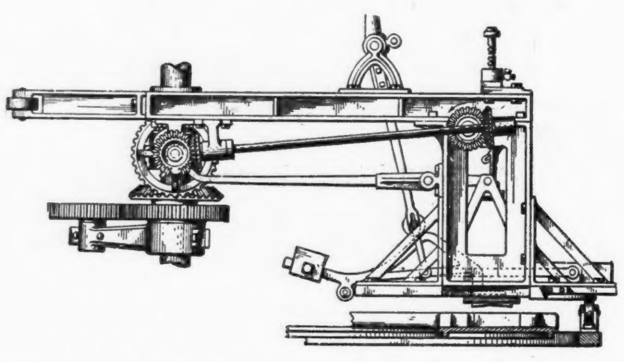
kept comparatively cool, even during long-continued use, it is less liable to inaccuracies arising from variations in temperature. The moving parts of the instrument, as will be seen from the smaller view, are very light, and the inaccuracies which arise from heavy moving parts are largely eliminated. The indicator is made in two sizes, the larger size giving diagrams up to 3 inches in height, intended for speeds up to 250 revolutions per minute. The smaller-sized instrument gives diagrams 1½ inches in height, and is useful for speeds varying from 250 to 500 revolutions.—*Practical Engineer*, London.

A NEW MOULDING MACHINE.

Quite a departure in moulding machines is shown herewith, being the invention of Mr. Orren Bryant, of Buffalo, N. Y. The rotating table shown in the upper figure, carries a series of flasks, which pass in turn through the different operations. Each mould receives an exact amount of sand, the same ramming by sets of hammers, is planed to size, lifted and held till taken away by the men in charge. Many of the details can be seen by a careful examination of the cuts, so as to give a general idea of the machine. It is, of course only applicable to such work as is required in large quantities, as the patterns must be specially made for







each piece moulded. As an example of its speed, it is stated that with ten men at work, 105 moulds for five-foot radiator loops were moulded, cores set and delivered at cupola ready for pouring, in 30½ minutes, without a bad mould and losing only two castings. The table turns once in 40 seconds on average work, making three moulds per revolution, but can be regulated to suit castings being made.

MAKING DIAMONDS.

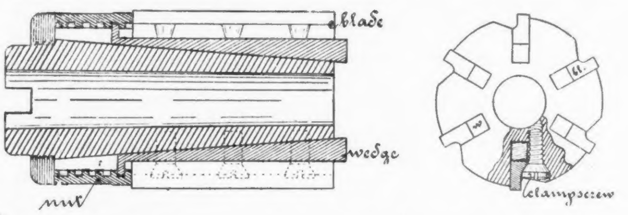
The making of diamonds from paste has been done for years, as many know to their sorrow, but the making of actual diamonds, from the same material and probably by the same method as the originals, is a new departure which has recently been accomplished by Prof. Henri Moisson, of Paris.

He obtained his carbon from sugar that had been heated until all hydrogen and water had been driven off. This he enclosed in a tube of pure iron and placed the whole in melted iron until the tube was also melted, then the whole mass was immersed in water until the surface hardened, after which it was left to cool

by degrees, the contraction exerting a pressure on the enclosed carbon sufficient to compress it into a solid mass, which forms the diamond. The iron was then eaten away by acid until the diamonds were reached, which stood every test and were in fact genuine diamonds artificially produced.

ADJUSTABLE REAMERS.

Few mechanics have not tried their hands at making an adjustable reamer, and the one shown with this will be of interest to every one who has been in the shop. These are used by Ott. Mergenthaler & Co., of Baltimore, Md., well known in connec-



tion with the Linotype machine. The body is of machinery steel, the blades being held in place by screws which clamp them against the side and bottom of their seats. The screws are numerous enough to make the reamer practically solid. The cuts are reproduced from the *Iron Trade Review*.

ANOTHER WONDERFUL ENGINE.

St. Paul, Minn., Nov. 14.—[Special.]—A small rotary engine of novel design has been invented by Grant Brambel, of Sleepy Eye, Minn., for the patent of which H. F. Allen, of London, president of an engineering syndicate, has offered him $1,600,000.

The engine does away entirely with the crank motion of the steam engine, a most desirable, but to all intents and purposes an impossible thing to do. The engine uses its own plunger for a cut-off. The engine is steam tight, and requires no ring packing. It can be made marine type, and of course can be either simple or compound.

It is not a cheap machine, although it costs very much less than the ordinary engine. It weighs less and occupies only fraction of the space of the old style engine. Mr. Brambel says: "When anyone can build a fifty horse-power engine that can be carried around in a hand satchel he has something that is very valuable, particularly when that engine is adapted to any and all kinds of work wherever power is used. The Brambel engine of fifty horse-power, weighing less than a hundred pounds, may be attached to the end of the armature of a dynamo and all the belting done away with, or a Bramble engine not larger than a common saucer could be attached to a creamery separator, and set it whirling at the rate of 6,500 revolutions a minute. The largest of these engines, 250 horse-power in size, is less than a foot wide at the base and eighteen inches high. It is in use in a dynamo room at Trenton, N. J., and the firm say they never had a more satisfactory machine. The patent was obtained a year ago, since which time several machines have been built and put into use."—*Daily Paper*.

If Mr. Brambel has not accepted the offer for his patent, we advise him to do so immediately, and we should not hesitate to throw off the five ciphers to make a deal and let it go at $16 even —anything to make a trade.

We agree with Mr. Brambel that an engine such as he mentions would be very valuable; but until we see the engine developing 50 HP. and "heft" the satchel, we remain skeptical—a veritable doubting Thomas. Economical use of steam is also a point to be considered before we see the use of this engine becoming universal, although for certain places this is not a vital defect; but unless it is 50 per cent. more economical than any rotary we know of, the boiler will have to be as much larger than the ordinary as a Saratoga trunk is larger than the satchel which holds the famous 50 HP. engine. This is probably the forerunner of a stock company—headed by names with M. E., E. E., A. B., etc., etc., after them, and credulous investors will soon wonder where the dividends are keeping themselves.

* * *

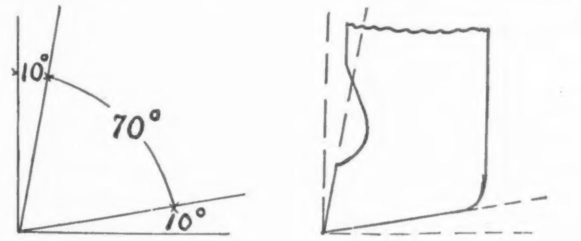
A NEW COAST LINER.

The latest addition to the Plant Line of steamships, *La Grande Duchesse*, has just been made ready for service. It is without doubt the finest coastwise steamer in the service. It is 404 feet long over all, 380 feet between perpendiculars. There are eight Babcock & Wilcox boilers, 14 feet in diameter by 11 feet 3 inches long, carrying 225 pounds of steam. Each of the twin-screws has an independent quadruple expansion engine, with cylinders 24, 34, 48 and 68 inches by 42 inches stroke. It can accommodate 700 passengers, and is in charge of Capt. Hanlon.

HOW AND WHY.

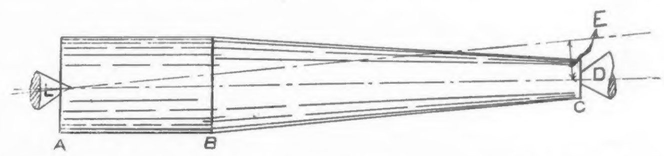
A COLUMN INTENDED TO CONTAIN CORRECT ANSWERS TO PRACTICAL QUESTIONS OF GENERAL INTEREST. GIVE ALL DETAILS AND YOUR NAME AND ADDRESS, WHICH WILL NOT BE PUBLISHED UNLESS DESIRED.

16. B. R. A.: What is the best angle for grinding lathe tools for iron work—to be more explicit, take a diamond point tool. *A.* The accompanying sketch gives common practice in a great many



shops. For soft iron we should give a little more top rake, say 15 degrees instead of 10, and reduce the clearance to 5 degrees, so as to support the cutting edge more thoroughly. This will give a shearing cut, and the edge being well supported will prevent excessive breaking of the point.

17. R. E. S. asks how much to set over the tail-stock to turn a taper 10 inches long on a piece of stock 14 inches long, the taper to be from 1 inch at the small end to 2½ inches at the large end. *A.* No positive rule can be given on account of the variation in the depth which the centers enter the work. The best we can do is to give an approximate rule which will be fairly close, the exact taper being obtained by adjusting the tail-stock in the desired direction after getting down nearly to size. With this rule the taper will be a trifle more than calculated, owing to centers, as before stated. In making the final adjustment be sure the point of your tool is in line with your centers (vertically), or each time you take a cut you will change the taper even without changing



tail-stock. Subtract the diameter of the small end of taper from the large end and divide this by 2. When the taper runs the whole length this is sufficient. In cases like this, multiply the offset as already found by the total length of the piece and divide by the length of tapered portion. The cut will make this clear. Working out this example we have, 2.5 inches minus 1 inch = 1.5, dividing this by 2 gives .75 of an inch to set over tail-stock if pieces were tapered the whole length. Multiplying .75 by the length (14) gives 10.50 inches, dividing by 10 (length of taper) gives 1.05 inches as offset for tail-stock or dead center.

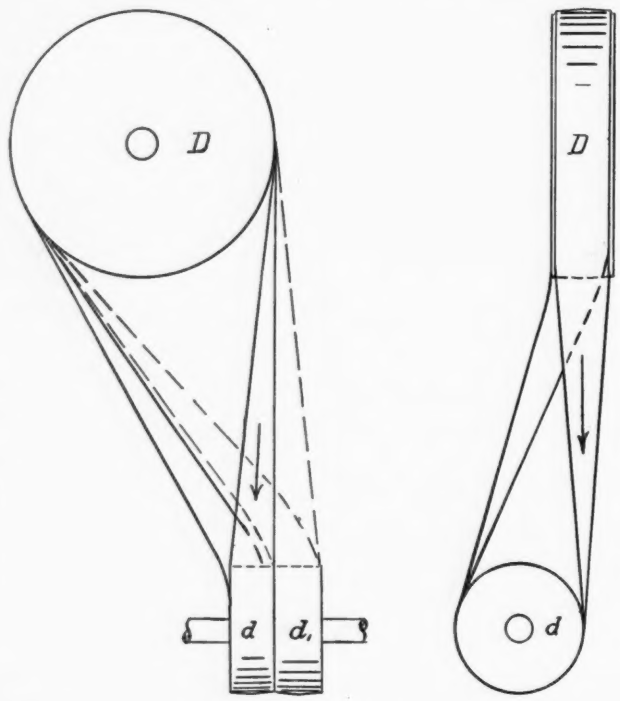
18. "Teacher" writes: If we have a vertical pipe of one square inch area and 100 feet high, with a horizontal plunger of three square inches area, attached to bottom of pipe, would the pressure per square inch on plunger be the same as if the pipe was also three square inches area? Or will the pressure of the one square inch in pipe divided among the three square inches of plunger, making the *total pressure* on plunger same as if it were one square inch area? *A.* The pressure *per square inch* of a column of any liquid depends on its height and not on its area. The *total* pressure of course depends on both height and area. The *total* pressure on a piston situated as you mention will be its area multiplied by the pressure per square inch due to the height of column.

19. J. T. B. asks about the effect of crossing the eccentric rods in a link motion. *A.* With *open* rods the lead increases from full gear to mid gear, and with crossed rods this is reversed; the lead decreases from full gear to mid gear.

20. A. R. L. asks for information about coloring steel black. *A.* A French process, said to be successfully applied for coloring iron and steel a dead black, depends upon the employment of a particular description of fluid, the formula of which is given as follows: One part bismuth chloride, six parts hydrochloric acid, five parts alcohol, and fifty parts water, these being mixed together in a thorough manner. In order to secure the most satis-

factory results—the article to be treated being first made clean in every respect and free from grease—the preparation is applied with a swab or brush, or, better still, the object may be dipped into it, the liquid being allowed to dry on the metal, and the latter then placed in boiling water and the temperature maintained for half an hour. If after this the color is not so dark as may be desired for the purpose, the operation is simply repeated, the required density being thus easily attained, and after obtaining the desired degree of color, the latter is fixed, as well as improved generally, by placing for a few minutes in a bath of boiling oil, and heating the object until the oil is completely driven off.

21. A. C. S. asks about a floor countershaft for a machine which requires a quarter-turn belt. *A.* In such a case we must compromise between the tight and loose pulleys d and d_1, and line the shaft with the discharging side about midway between



them, or where they come together. By the use of crown pulleys the belt will probably stay in place without much trouble. The sketch shows an exaggeration of the case due to a very short distance between centers of shafts.

* * *

The Dodge Mfg. Co., Mishawaka, Ind., makers of the well known Independence wood split pulleys, inform us of the decision of Judge Sage, of Cincinnati, O., in their suit against Post & Co. for infringement of patent, which has been pending for about five years. The defence evidently secured all the available evidence which would tend to show that pulleys of this kind were made previous to the Dodge & Philion patents. How well they succeeded will probably be judged differently by different parties, but the ruling was in favor of the Dodge Mfg. Co. According to this decision, however, every one using pulleys of this kind made by other concerns are liable to damages, although it is not likely these claims will be pushed, except in future cases. We can now enjoy the benefits of a monopoly patent.

* * *

WHAT MECHANICS THINK.

THIS COLUMN IS OPEN FOR THE EXPRESSION OF PRACTICAL IDEAS OF INTEREST, TECHNICAL OR OTHERWISE. WRITE ON ONE SIDE OF THE PAPER ONLY, AND BOIL IT DOWN.

WHEN SKETCHES ARE NECESSARY TO ILLUSTRATE THE IDEA, SEND THEM ALONG— NO MATTER HOW ROUGH THEY MAY BE, WE WILL SEE THAT THEY ARE PROPERLY REPRODUCED.

WHY NOT ADOPT PROF. SWEET'S SUGGESTION?

Somehow there are a good many valuable suggestions that you do not make any mistake in charging to Prof. Sweet, so on general principles I shall express the opinion that it was he who about the time of the formation of the American Society of Mechanical Engineers, suggested that it would save future misunderstandings if stationary engineers took unto themselves the name "enginist," as one expressing their vocation. Just at the time it hardly seemed that much inconvenience would come in the matter, but the inconvenience seems to increase. To the question, What does Stebbings do? the answer is straight enough if he happens to be a civil engineer, or a marine engineer, or an electrical engineer; but if he is a mechanical engineer, or a stationary engineer, the answer is rather certain to be: "Why, Stebbings is an engineer."

I am not arguing for a change in the title of the N. A. S. E. That title is pre-eminently theirs, and leads to no confusion; but in speaking of the individual members of that association, if they were referred to by the distinctive designation, "enginist," one would know just what was meant without any further explanation. It would save both words and mistakes. The word is in every way an appropriate one, and ought to be coined.

Frank Gleason.

THE DESIGNS OF CAST FLY-WHEEL SECTIONS.

"The design of wheel is open to criticism to this extent: That the makers were guilty of providing four ribs 1¾ inches thick by 3 inches deep, to strengthen or stiffen a mass of metal 3 inches thick by 52 inches wide. What is the result? In the mould these thin ribs chill, shrink and solidify at once, qualified by their proximity to the mass of metal in the web. The greater mass, cooling more slowly, shrinks upon these ribs with enormous force. One of these effects will ensue: (*a*) The ribs, still in a plastic condition, may *give* to the shrinkage. (*b*) The ribs more nearly solid, may resist this crushing force and cause a corresponding strain on the web. (*c*) This strain may be so great as to cause a fracture of the casting in the mould."

Comment.—(*a*) No harm will result except at points where spokes are secured. Here a plate 18 inches long covers and connects adjacent ribs. This plate will surely solidify before the rim, and when shrinkage of the rim follows, a shearing disturbance of crystallization must take place between the plate and ribs, leaving the iron in a dangerous weakened condition.

(*b*) Internal strains in castings are universally recognized as dangerous and need not be dwelt upon.

(*c*) The result is to the dismay of the moulder and the safety of the public, perhaps. If the moulder is wise and changes the designs, well and good.

I do not claim that the numerous recent fly-wheel accidents are due to bad castings. But in every case which has come to my notice the *design* has been open to criticism, or the casting has been full of blow-holes. Since the era of high speeds and amateur electrical engineering, accidents have multiplied, due, I believe, to preventable causes.

E. J. M.

ABOUT FRICTION WHEELS.

A correspondent asks us:

1. How do you calculate how much power may be transmitted by contact of the periphery of a driven disc with the side of a driving disc?

2. As it is useless to apply more power to the driving disk than the driven periphery can receive and transmit, and as there is in any case but one point on each in rolling contact, then is not the power thus transmitted a definite quantity without regard to the strength of the mechanism beyond the requirement?

3. How is that quantity expressed?

4. How much can be gained by widening the periphery beyond the width of the theoretical line that bears on side of driving disc?

5. Since by increasing the pressure of the periphery against disk the friction in the various bearings is also increased until the periphery simply slides on face of disk, how is the proper degree of pressure calculated?

6. Can you recommend a book on these and similiar problems?

[We have endeavored to obtain data on this subject from those using friction devices and find that few have any rules to work from. Most of them make the wheels of such sizes and width of face as mechanical judgment dictates and let friction take care of itself. Who has any reliable data on this subject? Ed.]

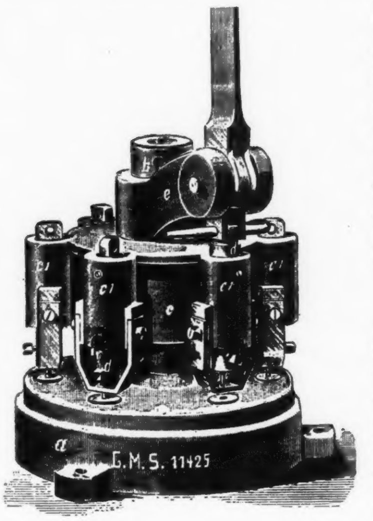
SCREW DRIVERS.

I have never seen a screw-driver that could be used in a lathe chuck or an upright drill. Can you inform me if there is such a screw-driver on the market, and will you please ask the readers if any of them know of one.

T. S. C.

REVOLVER PUNCH.

I found in a file factory in Rodeberg, Saxony, a revolver punch which was much used in certain special work in punching different thicknesses of sheet steel with different sized and shaped holes. This rig had six punches and dies always mounted and ready for use, without the necessity of finding the right punch and die, setting them both and adjusting them, whenever a particular size or shape was needed.



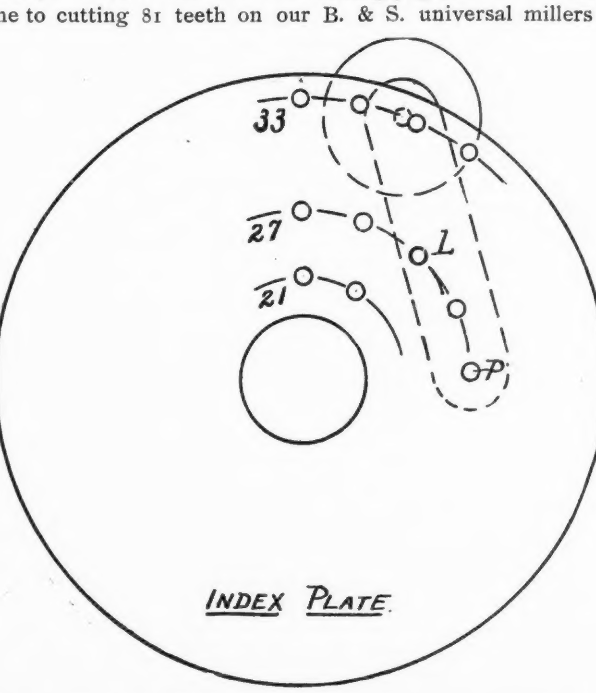
Refering to the illustration, *a* is a disk with a high border, fastened to the work bench; *b* an upright stem, solid with *a; c*, a collar bearing six arms and rotating about *b*. In each of these arms c^1 there is a punch-holder *d*, and below it in the disk-shaped under part of the collar *c*, a die, *e*, is an arm fast on the upper end of the stem *b*, and serving as a fulcrum for the cam-lever operating the punches.

To use any particular punch, the lock-pin at the back is pulled out, the disk rotated until it brings the right punch and die under *c*; then the lock-pin is snapped into the proper hole, and the punch-stem *d* made fast to the stem actuated by the cam and lever.

The smallest size weighs about 70 kilograms (say 154 pounds) and punches wrought iron up to 5 mm. = say 0.2 inch thick, 7 mm. = say 0.28 inch in diameter. It saves much time and is very handy.

SPACING ODD NUMBERS OF TEETH.

Some time ago I wanted some of the students to make a few ⅛ inch pipe taps. Then the search began for a lathe which would cut 27 threads per inch, but there was no such lathe in the shop. About that time I would liked to have met the man who originated the idea of using such threads as 11½ and 27 per inch. To use the most convenient lathes, change gears of 81 teeth were needed, and some blanks were accordingly gotten out. When it came to cutting 81 teeth on our B. & S. universal millers the trouble began, as there was no index plate that would space such a gear. Walter Gibben's card of compound index movements was consulted, but gave no solution. Following out his scheme, however, I found that a compound movement of the index pin and plate represented by fractions $\frac{6}{27}+\frac{9}{33}$ would give the required $\frac{1}{81}$ part of a turn of the gear blank, or $\frac{40}{81}$ part of a turn of the index pin, with an error of only $\frac{1}{440}$ part of the pitch. The blank was then set and 27 spaces cut around, and then the index pin moved forward 6 holes in the 27 circle and the plate and all moved in the same direction, 9 holes in the 33 circle and 27 spaces cut around again and the process repeated once more. It is much more convenient to divide the whole number of teeth up in this way, and in this case made possible the use of a setting not absolutely correct, as the error added up only twice, making two teeth each $\frac{1}{440}$ of the pitch too thin and one tooth $\frac{2}{440}$ too thick, and so on all the way around the gear. This error was too small to be at all noticeable.



Recently we had to cut a 63 tooth gear under similar circumstances. This was easily accomplished by the use of a link on the back of the index plate, as shown in the sketch; L is the link drilled at one end to fit the stationary pin at the back of the plate, and at the other end carrying a pin P wnich fits the holes in the plate. To cut 63 teeth, the index pin (not shown) is set in the 21 circle and the pin P holds the plate by being inserted in a hole in the 27 circle. The compound movement is $\frac{11}{21}+\frac{3}{27}$, and exactly the same method used as in the case of the 81 tooth gear. For 57 teeth the movement is $\frac{6}{18}+\frac{7}{19}$; 114 teeth, $\frac{13}{19}-\frac{6}{18}$; and 111 teeth, $\frac{1}{37}+\frac{13}{39}$. The minus sign indicates that the movements are to be in opposite directions.

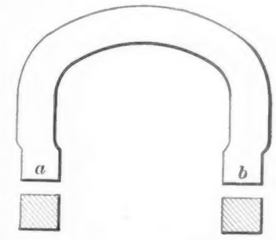
Excepting the prime numbers above 50, this completes Mr. Gibben's table of compound movements up to 115 teeth. Above that I have not investigated.

F. J. HARTWELL.

Madison, Wis.

A CHEAP SNAP GAGE.

The use of snap gages is so convenient in many ways that nearly all shops would probably use them exclusively on standard work if they could afford them. The regular made gages are rather expensive for a small shop, although possibly no more so than their accuracy necessitates, and in many places a substitute will answer fairly well.



I went into a shop near here the other day and found the tool-maker busy making a lot of snap gages as shown. He took a ⅜-inch square bar of tool steel, cut it off the right length, offset (or "in" set) the ends as shown, and then bent to the desired size. The ends were hardened and ends and sides *a* and *b* were then ground on an emery wheel to the right size. This was not exact, in this case to within about $\frac{1}{100}$, but this was close enough for the work in hand, but much more accurate grinding can be done if you take enough care. These make a cheap gage, and can be afforded by any shop needing them, although they do not by any means take the place of the more accurate article.

J. H. C.

WATER-COOLING DEVICE FOR SHOPS.

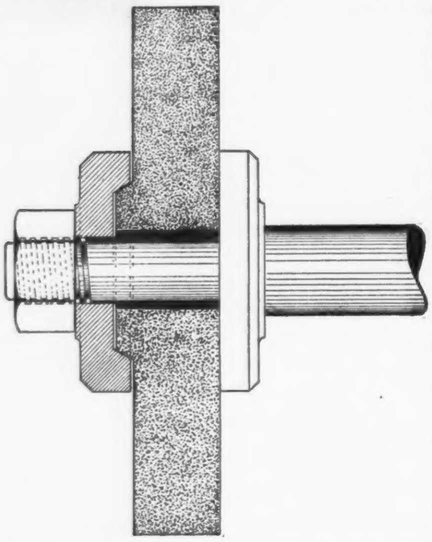
An apparatus (if so simple a thing deserves the name) for keeping water, etc., cool, and which is used in some German households, deserves notice from those who have in their employ many persons who have constantly to refresh themselves with a cool drink.

It is well known (and usually forgotten) that ice-water is injurious to teeth, digestion and kidneys; yet we swig it in quantities when it is to be had—for the principal reason that we have no good means of getting anything equally refreshing and less harmful. The Saxon device here described supplies the lack. It takes advantage of the fact that evaporation of a liquid from any surface cools the body from which it is evaporated, *i. e.*, that evaporation is caused by the absorption of heat by the evaporating liquid, from all immediately surrounding objects. A drop of alcohol or ether on the warm hand evaporates promptly and cools the surface from which it evaporates. A porous jar of water hung in a breeze becomes cool through the extraction of heat from the main body of water in the jar, by the small quantity which evaporates. A device on this principle, and called the "monkey-jar," is in common use in British India and other tropical countries.

The German device consists of a double-walled cylinder or muff of coarse woven wire (say ¼-inch mesh) with the space between filled with small bits of coarse-grained marble. The can of water, or other object to be cooled, is placed within the muff, and water is poured on the marble filling; the whole is then well covered (on top only) and set in a shady place; one where there is a breeze preferred. It works well and keeps butter sweet and cool. I think that pumice-stone would make a better filling than marble, as affording more surface for evaporation, as well as holding a larger supply.

THE LESHURE SAFETY COLLAR.

The cut below shows the method of preventing emery wheels from bursting; the collar bearing on the bevel portion of wheel. A 12 x 1⅛ inch emery wheel was tested with one of these collars at a speed of 5,600 revolutions, the listed speed being 1,800 revolutions. As the centrifugal force increases in proportion to the square of the velocity, it will be seen that in speeding the wheel to three times its listed speed, the centrifugal force was increased nine times. The wheel was then purposely broken in two pieces, clamped with this collar and run at a speed of 3,600 revolutions, or four times the strain at which the wheel was listed.



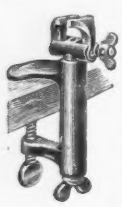
Its advantages are: The wheel cannot break away without first breaking the collars, which are of steel and heavy enough to withstand the strain. The collar is no thicker than an ordinary flange and can be used on any machine. No changes are necessary after wheel is put on; the collar being less than one-half the diameter of the wheel. This allows grinding on the side of the wheel.

The Hampden Corundum Wheel Co., Brightwood, Springfield, Mass., will give any further information.—*Adv.*

* * *

HAND AND BENCH VISE.

While the combination hand and bench vise shown herewith is not an absolutely new devise, it is such a handy tool that it deserves to be better known. It consists of a very substantial hand vise, with parallel jaws, moved by the thumbnut shown, while the handle has a hole through it to admit wire being passed through it, a handy feature, as all bench workmen know.



The bench attachment is shown in the larger cut, and consists of a forging which clamps to the bench and holds the hand vise as shown. It is one of the handiest tools of this class we know of, and is made by the Billings & Spencer Co., Hartford, Conn.

* * *

In a paper on the "Friction of Screws," before the A. S. M. E., Mr. Albert Kingbury, Durham, N. H., deduced the conclusions that the tests failed to show that any one of the metals developed less friction than any of the others, but the tests are specially interesting because of the great lessening of friction by means of graphite, as will be seen by the following:

Lubricator.	Minimum.	Maximum.	Mean
Lard Oil (heavy machinery)	.09	.25	.11
Oil, Mineral (heavy machinery)	.11	.10	.143
Oil and Graphite (equal volumes)	.03	.15	.07

In reply to a question that had been asked, Mr. Kingsbury said that the graphite used was from the Joseph Dixon Crucible Company, Jersey City, N. J. He said he did not intend anything in the way of an advertisement. He also added that he had tried to purify the graphite, but there was no gain. In order to satisfactorily employ the graphite the fit must be loose.

Some years ago, when Prof. Thurston was connected with Stevens Institute, he made a series of experiments to determine with scientific accuracy the value of graphite as a lubricant. He found that under the same number of pounds pressure, and traveling at the same rate of speed, the bearings lubricated with Dixon's graphite, mixed with enough water to distribute it over the bearings, did nearly three times more work than the best quality of winter sperm oil. He also found that with 15 per cent., by weight, of graphite was added to the best quality of lubricating grease, he was able to run the bearings nearly six times longer, at the same high rate of speed, than when the bearings were lubricated with the same grease, without the addition of graphite. Furthermore, where the graphite was used there was no cutting and the bearings were in perfect condition.

* * *

BUSINESS.

NO CHARGE IS MADE FOR THE INSERTION OF BONA FIDE ITEMS UNDER THE ABOVE HEAD. FOR FURTHER PARTICULARS, ADDRESS THIS OFFICE.

WE have an inquiry for a mill to grind bone and super phosphate very fine and without grains. It must be simple enough to be used by the poorest kind of labor.

MANUFACTURERS' NOTES.

THE NICHOLSON FILE CO., of Providence, R. I., report that the additions, repairs and extensions upon which they have been engaged throughout their four factories during the past few months are nearing completion, and that they will soon be in a position to handle with ease the increasing volume of business. The constantly growing export business of this firm, together with the prospect of a considerably enlarged demand from the home trade upon the return of commercial activity, necessitated some material changes about their works. Consequently an increased force of designers and draftsmen has been engaged in designing improvements in both buildings and machinery; the capacity of the former has been increased by a more judicious distribution of some of the machinery; while the large new annealing house, completed but a few months previous, has been perfected. Other minor extensions have also been made. A considerable number of new machines have been added to both the forging and cutting departments; while the output of the machines on hand have in many cases been doubled and in some even trebled by improvements. A new idea in rasp machines has been conceived and perfected that will enable an increased number of more efficient rasps to be turned out daily. Nor have the processes been overlooked, new ones having been introduced and old ones improved in all the departments. Altogether, the dull season during the past few months has proved valuable, in enabling them to prepare more completely for the future, and they are in better position than ever to handle any demands of business that may be made upon them.

AN order which the Westinghouse Machine Co. recently received through its Paris branch for a 1 200 horse power engine, similar to those exhibited by that company at the World's Fair, would seem to indicate that some features of the great Exposition made substantial and lasting impressions on our foreign visitors. The engine is to be used in an electric lighting station in France.

FIVE features of the New York Central are: The Empire State Express, the fastest and most famous train in the world; the magnificent North Shore Limited, for Chicago and the West; the superb Southwestern Limited, for reaching Cincinnati, Indianapolis and St. Louis quickly and comfortably; you travel in perfect security, protected every foot of the way by block signals; the free attendant service maintained at the Grand Central Station, New York.

ANOTHER instructor has recently been added to the already strong force of the Correspondence School of Technology, Cleveland, O., in the person of Mr. I. H. Sherwood, B. S., a graduate of Case School of Applied Science. Mr. Sherwood worked as a machinist before going to college, and worked his way through college as a machinist and by running the college engines, and is therefore able to fully appreciate both the value of an education, and also the trials and difficulties met by those who have to obtain same through their own efforts. Mr. Sherwood is now a stationary engineer and is also assistant instructor in the electrical engineering course of the Cleveland Y. M. C. A.

JOHN M. ROGERS announces that he has purchased all right and title to the Taylor-Rice Engineering Company's plant at Gloucester City, N. J., and that hereafter the plant will be known as the John M. Rogers, Boat, Gauge and Drill Works, where measuring tools of great precision will be manufactured; steam yachts and launches built to order, and compressed air and steam rock drills will be made a specialty. A new catalog in press.

THE BRADFORD MILL CO., Cincinnati, O., are full of business since election and running twelve hours. The Davis & Egan Co. added 100 men to their force in November and expect to take on 50 more this month. They say business is good. The Hoppes Mfg. Co., of Springfield, Ohio, received $12,000 worth of orders between the 5th and 20th of November, which is almost to a dollar the extent of their business for the preceding four months.

THE SPRINGFIELD MACHINE TOOL CO., Springfield, Ohio, are sending out a hanger, 16 x 24 inches, which shows very clearly the various tools made by them. These are to be hung on the doors of office or shop, and will help to relieve the barrenness of many a shop wall, as well as being an object lesson in modern tools. There is no descriptive matter given but it can be had for the asking and will help to bring out the special features of the tools shown. Clear illustrations, even without words, give anyone a good idea of the machine itself.

THE B. & O. R. R. is preparing to extend its compressed air plant at the Mt. Clare shops. A new locomotive repair shop is being built, and compressed air will be very extensively used. Two 50 ton cranes have been purchased for this shop and the power will be electricity furnished by the power station that also furnishes the electricity for the motors and Baltimore City tunnel.

THE WEBER GAS & GASOLENE ENGINE CO., Kansas City, Mo., feel rather elated over three orders received in one mail, for engines to go to Kaslo, B. C., Garanajuato, Mexico, and Eden, Florida. The great distance between these points show the engines to be widely known.

THE CLAYTON AIR COMPRESSOR WORKS, Havemeyer Bnilding, New York, report a contract with one company for twenty-five air compressors and twenty-five air receivers, of medium and small sizes,

delivery of the entire order to be made within six months from date. The indications point to a decided revival of trade in air compressors.

THE EAGLE LUBRICATOR Co., formerly of 106 Canal street, Chicago, advise us of the removal of their offices and factory to larger quarters at 267 St. Clair street, same city.

THE INTERNATIONAL CORRESPONDENCE SCHOOLS, of Scranton, Pa., have issued a little paper called "Self Help," which contains much valuable information and explains the method of their correspondence.

* * *

FRESH FROM THE PRESS.

Mechanical Laboratory Practice. Prof. C. H. Benjamin. Chas. H. Holmes, 2303 Euclid Avenue, Cleveland, O. 104 pages, 6 x 9 inches. Price, $1.50.

This is a hand book for students in the mechanical laboratory, containing descriptions of the more common apparatus used, with hints regarding their care and reports. It deals with the strength of materials, dynamometers, measurements of heat and steam, testing steam boilers, indicators and planimeters and testing steam engines. Although especially intended for students, it can well be studied by others who are endeavoring to obtain a mechanical education in their own time and manner, as it acquaints them with the apparatus in use in colleges and the manner in which the results are obtained. Prof. Benjamin is well known to our readers, and this book will be welcomed by those who are studiously inclined.

The "Practical Engineer" Pocket Book, 1897. The Technical Publishing Co., Ltd., 31 Whitworth St., Manchester, England. Price, 1s. 8d. net.

This edition is somewhat larger than the last, considerable data on mining engineering and machinery having been added, as well as other sections being enlarged and brought up to date. This is also true of gas and oil engines. Fresh tables have been compiled and Editor W. H. Fowler is to be congratulated on his enterprise and perseverance in this line. The diary portion, which is valuable to any draftsman or engineer, is printed on section lined paper, enabling sketches to be readily made, as well as affording lines for writing.

The Lehigh University, South Bethlehem, Pa.

We are favored with the prospectus of this well known college, outlining the courses of study in the different departments. Those most interesting to our readers are mechanical, civil and mining engineering, and the young men who are fortunate enough to complete these courses under such instructors as Profs. Mansfields, Merriman and J. F. Klein, should appreciate their opportunities. The address of Mr. John H. Converse, on Citizenship and Technical Education, is now printed in pamphlet form and is extremely interesting.

Bulletins of the University of Wisconsin, Madison, Wis.

These are interesting papers on various engineering subjects, and some of them are quite pretentious in size and scope. "Railway Signalling," by W. McC. Grafton, is very interesting, but the paper by L. F. Loree, on the "Emergencies of Railroad Work," is not as reliable concerning some of the recent disturbances as one could wish.

A Primer of the Calculus: E. Sherman Gould. D. Van Nostrand & Co., 23 Murray street, New York. Price, 50 cents.

This is another of Van Nostrand's science series, which has done much to put valuable information in convenient form and at a price that makes it accessible to all. This is the clearest explanation of this generally abstruse subject that we have seen, and the author used numerous diagrams to make clear his meaning and illustrate the reasons and basis of the science. Anyone who is interested in this branch of science should obtain a copy.

United States Geological Survey; Sixteenth Annual Report.

We have been favored with a copy of this interesting volume, which contains nearly a thousand pages and engravings, plates, etc., too numerous to mention, but which are both valuable and interesting. The work of this department is to be commended, as it is doing much to add to the world's knowledge of geological formation, and similar information.

* * *

ADVERTISING LITERATURE.

THE STANDARD SIZES FOR CATALOGS ARE 9x12, 6x9 AND 3½x6 INCHES. THE 6x9 IS RECOMMENDED, AS THIS SIZE IS MOST LIKELY TO BE PRESERVED.

DAKE ENGINE Co., Grand Haven, Mich. Catalog of Engines.

This is a 16 page catalog, 5⅛ x 8¼ inches, showing the peculiar features of the Dake square piston engine, together with data of the different styles and sizes which they make.

SIPP MACHINE WORKS, Grant Sipp, proprietor, Mill street, opposite Passaic street, Paterson, N. J. Catalog of small Engines and Boilers, 40 pages, 6 x 9 inches.

There is something so fascinating about the steam engine that nearly every apprentice wants to build one, and to these, as well as to the many who wish to gain experience in this line, this catalog will be very interesting. Castings are furnished, either rough or in various stages

of construction, to suit the tools of the purchaser, or the engines can be had completely finished.

They include the various types: horizontal, vertical, marine engines; gas, water and electric motors; boilers and their fittings, as well as model locomotives of the 870 class of the New York Central. Catalogs are sent for 10 cents, which is returned with purchase of $1.00 or over.

WATERBURY FARREL FOUNDRY AND MACHINE Co., Waterbury, Conn.

Recognizing the advantage of knowing when new machinery can be delivered, this company have issued a circular to purchasing agents giving a list of all the machines they have in stock, and it's a long list, too, so that an equipment can be selected, with the assurance that it will be delivered promptly. Those interested will do well to secure one.

WILSON LAUNDRY MACHINE Co., Columbia, Pa. Catalog of Laundry Machinery.

A 96 page catalog, 6¾ x 10 inches, showing the Columbia laundry machinery for the modern laundry. Many of the machines are interesting from a mechanical point of view, and any of our readers who intend going into the laundry business, cannot fail to be interested in the machinery shown.

BETTS MACHINE Co., Wilmington, Del. Extension Boring and Turning Mills, 16 pages, 6 x 9 inches.

This is a very tasty little pamphlet which gives just enough details to be interesting without being tiresome. We cannot refrain from quoting a little as it is also applicable to other cases "That this style of mill has become so popular is no small gratification to us. We were its originators and for many years its only promotors. We pushed it against the prejudices of many. * * * * * That we have removed prejudice is proven by the large number of machines we have installed * * * * and the activity of contemporaries in recommending and building these machines." The illustrations are excellent and it is sure to be preserved for reference.

KNICKERBOCKER ENGINE WORKS, Hartford, Conn. Catalog of the Knickerbocker Engine. 16 pages, 5x8¼ inches.

This is a neat catalog showing the details of the Knickerbocker engine, which are illustrated fully and described in a brief but interesting manner. This is a novel engine and one which will attract attention.

NATIONAL CHUCK Co., 39 Cortlandt street. Catalog of Chucks.

This shows the well known line of chucks made by this company, including the Errington tapping chuck and the Mischke die chuck. Those in want of a reliable chuck should get a catalog.

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U. BAIRD MACHINERY Co., Pittsburgh, Pa. General catalog. 656 pages, 9x12 inches.

This is essentially a dealers catalog, and will be found a great convenience to any one having the supplies of a shop to look after. From this any one can equip a complete plant, from pattern shop to tool room, and any one having charge of machinery will find much to interest them in this volume. The last twenty-four pages contain tables and other information for foremen and superintendents. They also issue a smaller edition, reduced by photography, which is nicely bound.

G. M. DAVIS & Co., 96 North Clinton St., Chicago, Ill. Catalog of steam specialties. 56 pages, 6x9 inches.

This contains descriptions of the Davis pressure regulator, back pressure valve, steam trap, damper regulator, pump governor, air valve, etc., etc. There are 14 pages devoted to information for engineers and others which will be found useful to many.

* * *

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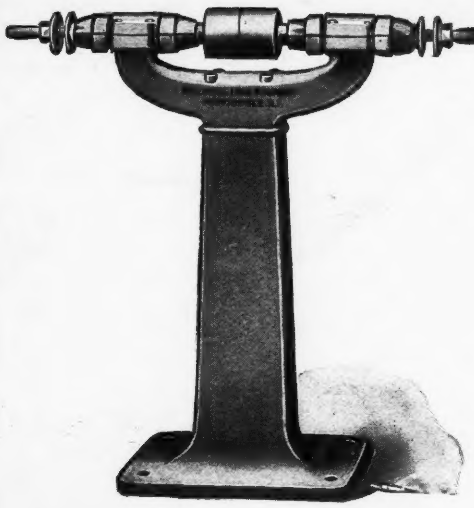

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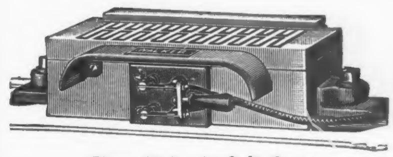

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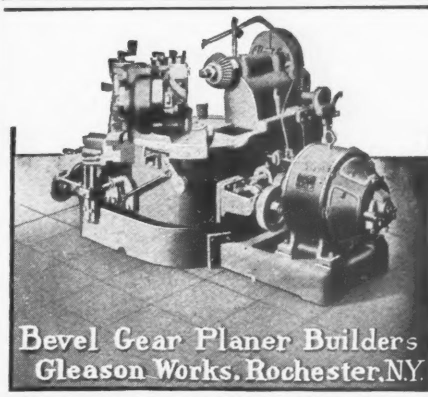

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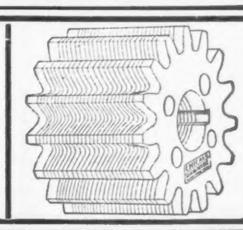

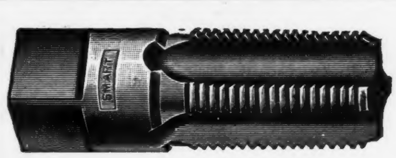

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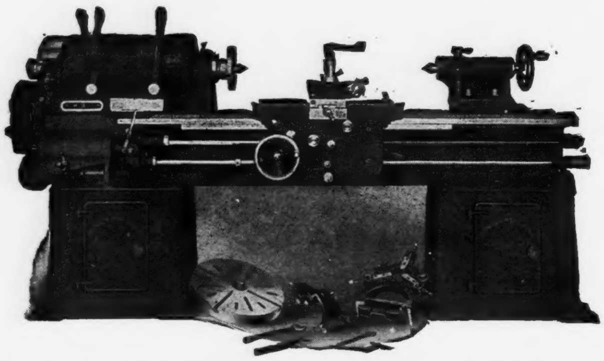

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